A NEW ERA IN THE TREATMENT OF OSTEOMYELITIS AND OTHER INFECTIONS

H. WINNETT ORR

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By

H. Winnett Orr, M.D., F.A.O.A., F.A.C.S.
Lincoln, Nebraska

Second Detroit Orthopædic Lecture

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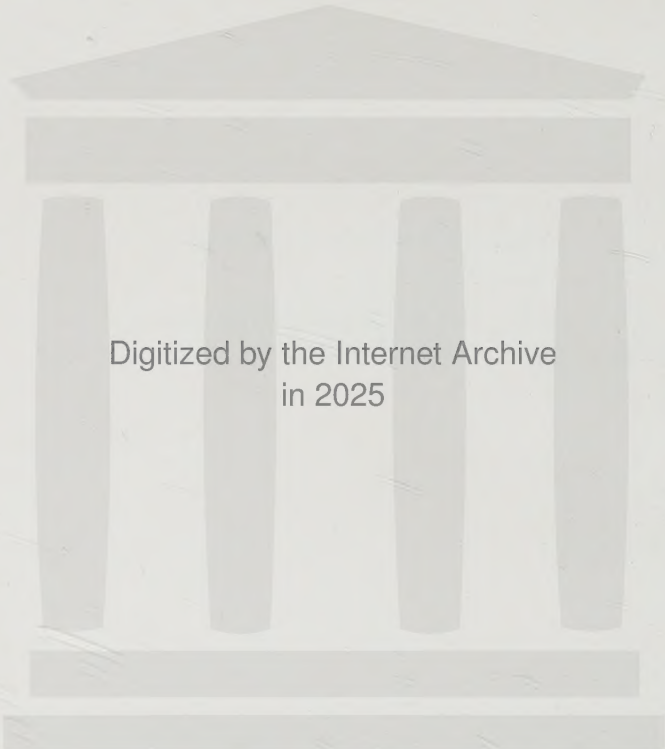
This small volume is inscribed
to the memory of

Rev. Hiram Winnett and
Dr. Hudson J. Winnett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PREFACE

The Detroit Orthopædic Lectureship was established November 24, 1922, to "foster orthopædic surgery at large and in our midst. The lecture is to be delivered under the auspices of the Wayne County Medical Society, by a man, not necessarily an orthopædic surgeon, chosen by the Lectureship Foundation Committee of the Society as the most distinguished and fitting for the purpose." The subject is to be "cognate to orthopædic surgery and of broad importance."

The first Detroit Orthopædic Lecture was delivered by Dr. Robert Bayley Osgood, Professor of Orthopædic Surgery in Harvard University, March 16, 1925. This lecture traced the development of orthopædic surgery from surgery in general. Dr. H. Winnett Orr, an orthopædic surgeon, in dealing with osteomyelitis and compound fractures, has come to a new understanding of the treatment of established and incipient sepsis, and, thus, through Dr. Orr, orthopædic surgery is repaying its debt to surgery in general. The Lectureship Foundation Committee feels that this new understanding of the treatment of established and incipient sepsis, under the leadership of Dr. Orr, is comparable to Lord Lister's explanation of the prevention of sepsis, and makes an important contribution to the whole surgical world.

(Signed) WILLIAM E. BLODGETT

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A NEW ERA IN THE TREATMENT OF OSTEOMYELITIS AND CERTAIN OTHER INFECTIONS

H. Winnett Orr, M.D., F.A.C.S.
LINCOLN, NEBRASKA

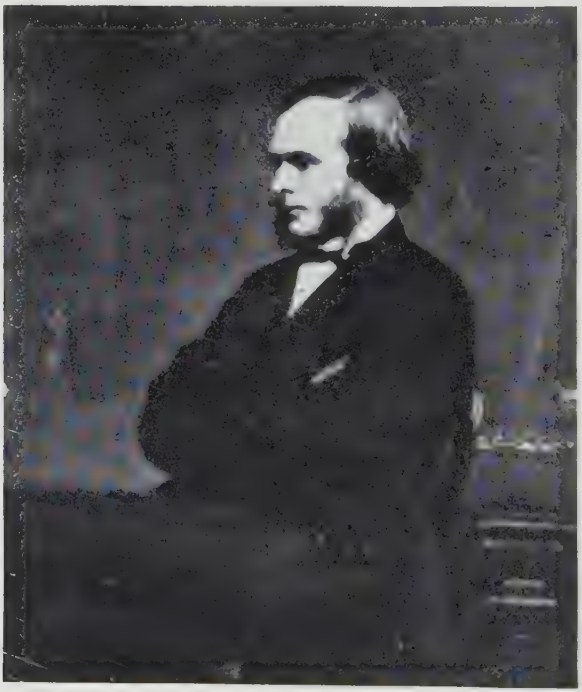
Wound Treatment Before the Time of Pasteur and Lister

In making any suggestion for the improvement of our methods in the treatment of osteomyelitis, compound fractures, and other infections, we should first of all make an acknowledgment of our great debt to Sir Joseph Lister.

The history of surgery divides itself naturally into two periods at the point where Lister adopted the discoveries of Pasteur and devised methods for their application to surgery. For the purpose of this address it is necessary for us to make a distinction between the prevention and the cure of sepsis. A study of the labors and writings of Lister will show that the ideal in his mind and in his work was that of excluding septic infection from wounds. Even in the employment of chemical antiseptics he adapted every detail of his method to the effort to keep the germs of putrefaction out of the wound and away from the wound surface. Since Lister's time we have wandered far from his ideals in an effort to employ anti-

Dr. Orr prefaced his formal address by saying: "Please allow me to acknowledge my appreciation of the invitation of your committee to contribute one of the lectures provided for in your Beaumont endowment for orthopædic surgery. It is a great privilege to be asked to speak under such favorable auspices and to be permitted to follow so distinguished a surgeon and teacher as my friend, Dr. Robert B. Osgood, of Boston."

septics for the purpose of combating infection in wounds. This effort to bring about a cure of infection or sepsis, whether local or general, by means of antiseptics, is the



Sir Joseph Lister at about the time of his first work on antiseptic surgery. Reproduced from "The Collected Papers of Joseph, Baron Lister," Oxford, The Clarendon Press, 1909.

effort with which it is my particular purpose to deal in this discussion.

I think we have made a mistake not only in employing

chemical antiseptics in this manner, but that we have made many other mistakes in departing from the rules laid down by Lister for the employment of the antiseptic method. It may be well to consider our entire subject this evening under three general heads—first, a short description of wound surgery before Lister, particularly with reference to surgical methods and results in the treatment of septic wounds; second, a review of the antiseptic method as conceived by Lister and as practiced—usually improperly—by surgeons since Lister's time; and third, a study of surgical methods and devices employed during recent years that indicate a tendency away from the antiseptic method and toward a simplification of wound surgery and postoperative technic.

It seems quite clear that as a method of cure as distinguished from one of the prevention of infection, the antiseptic method as employed since Lister's time has failed to give satisfactory results. A new method embodying well recognized surgical principles though in different combination will, therefore, be proposed for the treatment of osteomyelitis, compound fractures, septicemia, and other local and generalized septic infections.

I venture to suggest that a sense of the need for something of this sort was in the mind of Mr. John Fraser of Edinburgh when he made his remarks in regard to Lister in Turner's memorial volume.[227] Mr. Fraser said:

"Our work is full of mysteries, of difficulties and doubts, risks, and uncertainties. The ideals which Lister saw and achieved removed a mountain of mystery and filled a valley of doubt, but our path is still strewn with obstacles as terrible as those which Lister smoothed away. Is it that some of us cannot see the wood for the trees? Are we concentrating on a 'thousand peering littlenesses' while winged ambitions soar around? If it be so, we are but as one clothed in motley, idly passing by, and we are forgetting one of Lister's greatest heritages—the value of an ideal in surgical work."

Osteomyelitis as a clinical entity was first described in about 1854 by Chassaignac, but it had been mentioned earlier in the United States by Nathan Smith in 1789 and by his son, Nathan R. Smith, in 1834. Various organisms have been described as a causative factor.

For this occasion we shall speak of osteomyelitis in its broadest sense. Most of the attempts that have been made to classify osteomyelitis into acute, chronic, idiopathic,

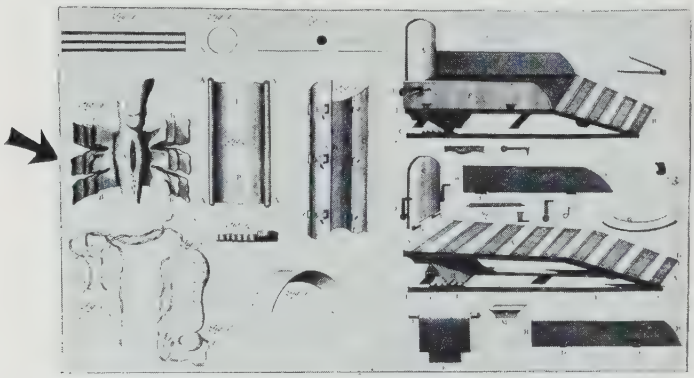


Fig. 1. Fracture apparatus and equipment from Heister's "General System of Surgery," London, 1768. The arrow points to "the bandage of eighteen heads" to be employed in compound fractures.

fulminating and postoperative, have no particular significance as far as treatment is concerned. We have bone infections which may be acute, subacute, or chronic. They are all bone infections, however, and must be dealt with according to well recognized surgical principles which, for the most part, have been disregarded. It is out of a desire to bring back into general use these neglected principles that I address myself to a discussion of this subject.

From the earliest times to the present moment surgical

writers on compound fractures have felt it necessary to provide methods that afford easy and frequent access to the soft part wound. The suggestion that this is necessary is often prefaced by an apologetic explanation that if possible the fracture must first be reduced and immobilized. That fracture immobilization and daily wound dressing are incompatible is seldom mentioned, but ge erally understood. Heister,[89] in 1739, refers to this in the following words:

"If a fracture is accompanied with a wound, after you have reduced the fractured bones you must first treat the wound in the same manner with other lacerated wounds; first, the wound is to be well cleansed with warm wine, Spirits of Wine, or salt water; in the next place, it is to be filled with dry lint, to stop the hæmorrhage; then to be dressed with digestive Ointment; lastly, it is to be anointed with some vulnerary Balsam till it is thoroughly healed. Since it is necessary to open the dressings every day, in order to cleanse the wound, but at the same time it would be of very bad consequence to move the limb, therefore a great length of bandage in this case would be very wrong, especially in the *Femur* or *Tibia;* for it would be troublesome to lift the foot up to roll on a long bandage, which would disturb the fractured bones, and throw them out of their natural situation: for this reason the best surgeons neglect the use of long bandages in this case, and apply the bandages of eighteen Heads, Plate IX, Fig 4,† which may be loosened at pleasure; when the wound is healed, which happens frequently before the Bones are united, you should lay aside the bandage of eighteen Heads, and bind up the Limb with long narrow Rollers, till the Cure is thoroughly perfected; but we shall explain this more largely below when we come to treat professedly of Bandages."

It is interesting to find in the writings of all the earlier surgeons discussions like the preceding which showed that they were having difficulty in compound fractures in reconciling treatment of the fracture and treatment of the wound. Certain methods of bandaging and cer-

†See Figure 1, this text.

tain kinds of splints are described in all of the earlier surgical writings, showing that the immobilization treatment of fractures was a well recognized surgical expedient; at the same time every surgical writer did what every surgical writer does now—namely, advocated the removal of splints, or at least their considerable modification in the presence of wound infection in compound fractures.

Another phase of this same difficulty is described by Heister,[89] who recites the experience of a previous French writer, Petit (1741), as follows:

"Petit describes the Case of a *fractured tibia attended with a Caries*: but as he had related the case of the tibia alone, neglecting to describe it as happening to other parts, he has in my opinion, by no means satisfied the Subject: however, this may serve as an example to be imitated in similar cases till we shall be furnished with more perfect ones: A young man who had been for some time troubled with an ulcer and Caries, about the middle of the Tibia, had the misfortune to break the bone in the very part, the fibula remaining at the same time whole; therefore no extension was required in the cure of this facture: Petit, in the first place took off all the vitiated flesh that was situated near the fractured part with his knife, and reduced the ends of the bone into their proper situation with his fingers, and then filled up the ulcer with dry lint, and covered all with the eighteen headed bandage as above: and after some days when the fever was quieted, he cauterized the extremities of the fractured bone that were affected with Caries, and afterwards took off the carious parts with the Trepan which the French call *Trepan exfoliatif*: Having done this he applied lint to the naked bone, well saturated *cum Tinctura Aloes*: but he dressed the fleshy parts first with *Unguento digestivo,* and afterwards *cum Unguento susco,* to keep down the luxuriancy of the hard flesh, which is very prejudicial in this case: and this Method of Dressing he continued for fifty days, till the disordered parts of the bone separated from the sound: he then began to encourage the growth of new flesh by applying vulnerary Balsams, and healed both the bone and ulcer after the usual method."

The illustrative case from Petit suggests one solution of the problem that is still with us—namely, the method of dealing with an infected wound in the presence of a bone injury. This is the particular problem which we have set ourselves to solve if possible, upon this occasion.

John Hunter[164] was the first to recognize, in what might be called a scientific way, the marvelous recuperative and reparative powers of nature. His statement of this problem of compound fracture in which there is infection is as much of a classic as many of his writings on other subjects. Hunter says:

"The only peculiarity in compound fracture by which it differs from other lacerated wounds, is the breach of continuity of the bone, which admits of motion in the part where none was intended. This singularity it is which requires a peculiarity in the treatment, as this motion and the operations of nature are in contradiction to each other. A variety of inventions have been employed to prevent this motion; but the dressing of the wound every day counteracts the effect of every invention that has been thought of, and it is perhaps impossible to dress the sore without motion. At first the part is generally put into a poultice, but changing this must give considerable movement. Instead of a poultice I would lay the leg or arm in cloths, doubled several times and wetted with goulard, and lap them over so as to come into contact. These should be wetted occasionally, and continued until the inflammation is over and the suppuration takes place. When the wound is on the back of the leg we shall be obliged to raise the leg every day to apply the cloths. A bit of oil-cloth should be put under the leg, and wiped clean every day."

It is interesting to compare the folded cloth of Hunter with the eighteen tailed bandage of the ancients; a rather less efficient device than the older one with the same object—easy access to the compound fracture wound! Ambroise Paré in the sixteenth century must have had a similar conception in mind in the employment of his celebrated phrase, "Je le pansay. Dieu le gaurit," but

he must have had great faith also in some of his fantastic and frequently applied dressings even after having abandoned the boiling oil of his contemporaries.

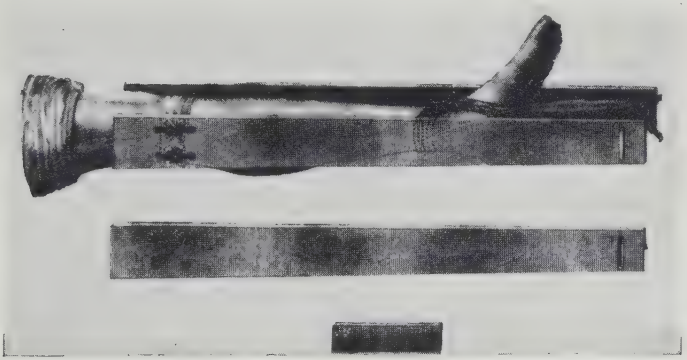
In describing the treatment of compound fractures John Hunter[164] makes an observation that might well be applied at the present time when one considers the numerous reactionary suggestions that have been made in regard to the treatment of compound fractures since the Great War. He says:

"When the ends of the fractured bones are pretty soon brought tolerably close together, I can conceive that union may take place in a simple fracture. Before the year of 1750 it was the practice to endeavor to bring the broken ends of the bones as near together as possible with little or no motion allowed: but after that a fashion arose (for we have fashions in surgery as in everything else, arising perhaps from a person happening to do well who had not been treated in the old way), of letting the parts separate and of not forbidding motion so strictly; but now caprice has, I believe, had its day, and we are taught by reason and experience that the parts should be when cured, as nearly as possible in their natural situation."

Even with the high mortality rate that prevailed in cases of amputation before the time of Lister, amputation was the common resort in compound fractures. Not only had no successful method been devised, as Hunter pointed out, of dealing with the fracture in such situations, but surgeons were completely at the mercy of infections of all kinds—hospital gangrene, erysipelas, and rivers of pus were the accompaniment of these injuries. Mr. Percival Pott[170] states the situation very well in the paragraphs that follow:

"The Baron Van Sweiten, writing as many others have done, that is, theoretically, on surgery advises us, in the case of very bad compound fractures, which may most probably require amputation, to defer the operation until we have tried the force of antiseptic fomentations and applications of like kind for two or

three days; and this opinion and advice, he builds, in some measure on a remarkable success of La Motte, in a seemingly desperate case, of a man's leg, mashed by the wheel of a heavy carriage. That La Motte's patient escaped, I make no doubt, because he has said so, but the surgeon showed much more rashness in attempting to save such a limb than he would have done in the amputation of it; the operation would have been more justifiable practice, with regard to the Baron's advice, to stay two



"The annexed plate represents the apparatus and its mode of application very intelligibly. It is particularly convenient in compound fractures, because the external wound *can be dressed daily,* without disturbing, in the slightest degree, the fragments of the bone; but it cannot be used in fractures near the knee or ankle joints, because the bands for extension and counter-extension would irritate the inflamed parts and could not be borne."—J. S. Dorsey, *Elements of Surgery,* Vol. I, p. 197 (1818).

Fig. 2. The above is reproduced from Dorsey's book to indicate that the daily dressing then as now dominated the care of compound fractures. The adaptation of splints to frequent dressings has been responsible (the present writer believes) not only for poor results in fractures, but for secondary and mixed infections and for much suffering and disability.

or three days, I take the liberty to add, stay several more, for at the end of that time (I mean two or three days) the patient will have very little chance indeed for the operation, much less than he would have had at the time of the accident.

"I should be very sorry to be thought a patron or an adviser of rashness or cruelty; but in what I have here said, I believe

I shall have every man in the profession, who has either true humanity or sound judgment founded on experience, on my side."

At the same time it must not be thought that no one was using simpler methods of dealing with these conditions. A recent writer, Myers,[143] calls attention to some of the historical references to devices of this sort dealing with compound fractures and infected wounds.

"Infrequent dressings is a corollary of that fundamental principle of absolute rest during the healing process. This principle is not new, for Bellaste, in 1707, said: 'I only dress a wound infrequently, convinced that we must give nature leisure to act in re-establishing wounded parts in their former state.' The elder Larrey shows how far he carried the principle of immobility and how little he cared to examine and dress wounds in soft parts by his treatment in the following case: 'This soldier whose arm I amputated at the shoulder joint, during the terrible battle of Moscow in 1812, at my request set out immediately on his journey homewards, without ever having the stump dressed, in accordance with the assurance that I had given him at his departure that he would not need it.'"†

This brief review of certain phases of surgical practice is not intended in any sense as a history of surgery before Lister's time; it is designed to bring out one principal point only; this is, that rest has always been considered to be an important factor in the treatment of injuries and inflammations, particularly those of bones and joints. The employment of rest will be found to be referred to in the writings of most of our best surgical writers throughout the entire history of surgery. Methods for the application of rest have always varied, however, and, as has been pointed out, have been subject to modification or discontinuance in the presence of acute infection.

†Since the above was written I have visited Professor Putti at Bologna and he has called my attention to the writings of Magatus "on the infrequent dressing of wounds" in the sixteenth century.

Then as now, activity rather than rest has always been the practice whatever may have been the rule.

The English writer, John Hilton, gave us one of the best treatises upon the indications for and the results of the employment of rest as a therapeutic method. It will be observed that many others, including John Hunter and even Lister himself, were either consciously or unconsciously endeavoring to make extensive use of physiological rest for obtaining results in these cases.

During the entire pre-Listerian period, that is, up to the middle of the nineteenth century, surgeons exercised very little control over infection in osteomyelitis, compound fractures, and other wounds. Occasional fortunate and satisfactory results were obtained. Even those patients who recovered after long periods of suppurating wounds and with extensive scar or with deformity and disability, were considered to have done well. In spite of the use of oils, balsams, and other antiseptics, hospital gangrene, erysipelas, and other forms of local and general infection prevailed wherever wounds were made or surgical operations were attempted.

It is important to observe that before Lister's time nearly all of these infections and infection complications occurred primarily. That is to say, the infection was introduced at the time of injury or operation. In our own time it has become the custom to do clean operations and to produce infections secondarily at the time of doing so-called antiseptic dressings. Compound fracture then led usually to amputation and amputation very commonly to a fatal termination. Surgical operations for these conditions and for other deformities of the extremities were attempted only rarely and even then were often followed by infection and fatal septicemia.

This was the state of surgery at the time when Pasteur

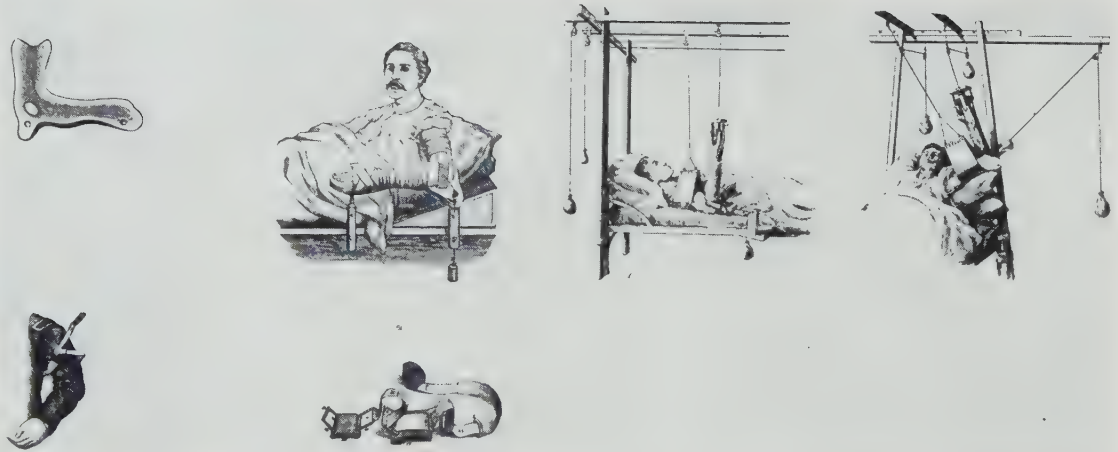


Fig. 3. A group of illustrations to show the similarity of methods in fracture treatment with an interval of sixty years. The four illustrations on the left are from the Surgeon General's "Surgical History of the Civil War" (U. S. 1861-1865), while the two on the right are from Keen's "Surgery," Vol. VII (W. B. Saunders & Co.) to illustrate methods in the Great War (1917).

came forward with his announcement in regard to organisms; the discovery which paved the way for Lister's remarkable and valuable contribution to surgical technic.

The Antiseptic Method as Conceived by Lister and as Practiced by Surgeons Since Lister's Time

Pasteur brought forward his discoveries in regard to fermentation and the organisms concerned in this interesting process about 1860. Lister had spent some years already in his study of the factors involved in inflammation and putrefaction in wounds. In his search for an agent that might influence the putrefactive changes in wounds he was directed to the work of Pasteur. In referring to this, Fraser[227] says:

"The importance of Pasteur's work was appreciated by three men in particular, Jules Lemaire, Spencer Wells, and Joseph Lister. There may have been others, very probably there were, but as far as these men are concerned, they made written record of their appreciation. Yet how differently they used the knowledge that lay to their hands. Lemaire recognized in some measure the value of carbolic acid as an antiseptic, but his sense of judgment failed to see its limitations. It became to him a panacea for a great variety of diseases; he advocated its use in such a variety of ills that ridicule was poured upon both the substance and its sponsor, and the idea was killed so far as Lemaire and his associates were concerned. Spencer Wells used Pasteur's work and its relation to surgery as the theme for his address at the meeting of the British Medical Association in 1864, but we have no evidence that he carried his ideas, pregnant with possibilities though they were, beyond the stage of hypothesis. The way in which Joseph Lister used the knowledge is a matter of history."

In speaking of Lister's spirit and work at this time another of his pupils and house surgeons, F. L. M. Grassett,[227] refers to him as follows:

"Lister was then about forty-two years of age, just in his

prime, with a commanding figure and a beautiful, thoughtful face. The earnestness with which he spoke increased the slight hesitancy of speech peculiar to him, yet adding force to his words. I think all who heard him speak felt that a new era of surgical work and teaching had opened in Edinburgh. He claimed to be endeavoring to treat surgical cases in such a manner as to prevent the occurrence of putrefaction in the part concerned. 'If this is done,' he said, 'injuries formerly regarded in the gravest light become comparatively trifling and some diseases rarely admitting of cure, terminate most satisfactorily in perfect recovery. The guiding principle of its practical details is the germ theory of putrefaction."

It is neither necessary nor important to describe in great detail the work that Lister was doing at that time. He himself has told us that his effort was to devise an efficient but harmless method for keeping the organisms of putrefaction out of wounds. He followed the experiments of Pasteur with regard to the filtering of organisms out of the air and in regard to the influence of chemicals upon germ growth. He pursued a long series of independent experiments upon the conduct of the lactic acid bacillus in milk and made these experiments instead of his more interesting clinical experience the basis of his introductory lecture when called to Kings College in London in 1877. Anxious though he was to carry the battle against the organisms as far as possible he advised against much activity on the part of the surgeon in the wound itself. Chemicals were not to be applied directly to the wound surface and every precaution was to be observed to avoid damage to the healing tissues.

Lister had a large following among the students of both Glasgow and Edinburgh and distinguished visitors from foreign lands. That some of his own countrymen (G. H. B. MacLeod)[42] recognized the possibilities of the antiseptic method is indicated by the following:

"Even in the most serious wounds in which the bone and deep tissues are widely implicated the careful management of them by the method so minutely described by Mr. Lister has been found to succeed. . . . That very much can be done by the careful development of this system of practice and that much more may be expected of it than has ever yet been accomplished no one who has read Mr. Lister's able papers can doubt."

There was great opposition, however, from contemporary surgeons to the methods proposed by Lister. Some refused to accept the germ theory, some claimed equally good results from ordinary cleanliness and many resented the criticism of their methods implied by Lister's teachings. Others soon departed from this teaching, and, whether they influenced Lister's practice or not, the accounts of his work seem to be influenced by this practice on the part of others. Mr. Rutherford Morison,[227] one of his old assistants, describes the technic employed in the clinics at Kings College about that time:

"One or more large drainage tubes were placed in every wound, catgut ligatures and silk soaked in 1 in 20 carbolic lotion secured the blood vessels and closed the incisions. A strip of green protective dipped in carbolic lotion covered the wound to prevent irritation from the antiseptic in the dressings; over this was placed a pad of carbolic gauze, and covering all was a large dressing of eight layers of carbolic gauze, with a sheet of jaconet between the seventh and eighth layers to prevent blood or discharge from coming directly through the dressing. A bandage of the same gauze, sufficiently adhesive to prevent its slipping, and safety pins, completed the dressing.

"Dressings were changed at once if blood or discharge came through. If not, they might be left on for two or three days. During the time of my service only one wound suppurated. The patient, a man, had had parts of his scapula excised for sarcoma. At the operation the spray broke down and this explained the failure."

Lister's capacity as a teacher hardly requires discussion, but there is one illustration so striking that it deserves repetition here. In speaking[124] of the exact man-

ner in which the access of air to wounds brings about putrefaction he uses punctures of the pleura to make his point in the following manner:

"A beautiful illustration of this doctrine seems to me to be presented in surgery by pneumothorax with emphysema, resulting from puncture of the lung by a fractured rib. Here, though atmospheric air is perpetually introduced into the pleura in great abundance, no inflammatory disturbance supervenes; whereas, an external wound penetrating the chest if it remains open, infallibly causes suppurative pleurisy In the latter case the blood and serum, poured out into the pleural cavity, as an immediate consequence of the injury, are decomposed by the germs that enter with the air, and then operate as a powerful irritant upon the serous membrane. But in case of puncture of the lung without external wound, the atmospheric gases are filtered of the causes of decomposition before they enter the pleura, by passing through the bronchial tubes, which by their small size, their tortuous course, their mucous secretion and ciliated epithelial lining, seem to be specially designed to arrest all solid particles in the air inhaled. Consequently the effused fluids retain their original characters unimpaired, and are speedily absorbed by the unirritated pleura."

The careful manner in which Lister carried his theories and laboratory experiments into his clinical work is revealed by careful reading of his case reports. In one of his earliest papers† he makes it quite clear that the intention of the carbolic acid dressing, whether primary or secondary, is to serve as a barrier against the invading organisms. It was frequently pointed out that antiseptic chemicals were not tolerated by, nor were they to be applied directly to, the human tissues. While the wound was dressed frequently, there was little actual disturbance of or damage to the healing surface. The edges and the outer surface of the clot or crust only were being given the active antiseptic treatment which most of Lis-

†Lister, Lord: Collected Papers, Vol. II, p. 1. See bibliography, reference 124.

ter's followers ever since have carried into the wound itself.

In Lister's case No. 2 in the paper referred to above, he pointed out the necessity in some cases of special measures to favor drainage, and employed a warm and moist application to soothe the part and also to insure the escape of exudate. This was applied outside of the "carbolic crust."

It is upon this feature of Lister's practice rather than upon his far more important and fundamental teachings in regard to the exclusion of infection and protection of the wound that surgeons have seemed to concentrate ever since. Lister's ideal, which was to keep out the infective agents and to protect the wound surface, has been almost entirely abandoned with only drainage and the futile attempt to combat infection in the wound (even in compound fractures) the principal objects of surgical treatment. In the latter we have not only failed, but in the process of failure have done enormous damage in the way of delaying healing, metastasis of infection, unhealed and ununited fractures, deformity and disability. That many cases of septicemia are aggravated or induced by excessive zeal in wound treatment, I think there is no doubt. And the point that we must not forget is that much of this difficulty arises out of a disregard of the Listerian teachings of sixty years ago.

These modifications of and the departures from Lister's technic are due in part to our failure to be guided by him, and in part to our anxiety to improve upon an original method which we have not even taken the pains to understand.

These phases of Lister's work also are alluded to and explained by Fraser[227] in a continuation of the remarks previously quoted:

"Among the greatest of Lister's achievements was his successful effort to put surgical work upon such a footing that it fulfilled in part, at least, the exacting definition of a science. A scientist has been defined as one who is concerned with the investigation, the scrutiny and the weighing of facts, and the

SURGERY, GYNECOLOGY AND OBSTETRICS

THE TREATMENT OF FRACTURES BY NAIL EXTENSION

A Preliminary Report

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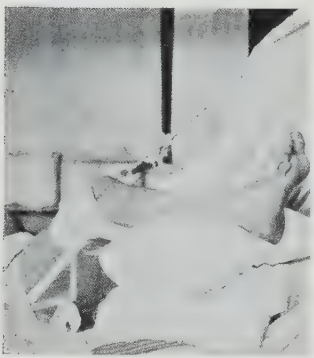

Fig. 2. Showing patient in bed and weight applied for fracture of upper part of leg.

CONCLUSIONS

Advantages. 1. It is less dangerous than the radical open operation.

2. It enables the surgeon to exert the maximum amount of traction while using the minimum area for the attachment of the traction apparatus.

3. It will bring about a reduction of the deformity in old cases where other methods fail.

4. The technique is not difficult and can be mastered by anyone. Therefore the method is practical and can be used by the entire profession.

5. It gives access to wounds in compound fractures, permits of frequent dressings, and does away with unclean, infected fixation apparatus.

Disadvantages 1. Apparent brutality of the procedure. This is not real, however, as the patients suffer no more by this traction than by any other method.

2. Danger of infection. This is less than the danger of an open, radical operation.

3. Hæmorrhage. This may occur but can always be readily controlled by enlarging the incision and tying off the bleeding point.

Fig. 4. The above has been reproduced to indicate how even the more elaborate fixation and traction devices have been modified to permit frequent antiseptic dressings, irrigations—and, incidentally, improper motion.

definition is as applicable to the best type of surgical investigator as it is to the chemist, the metaphysician, or the engineer. Anyone who reads Lister's papers cannot fail to be impressed by his extraordinary passion for facts, his desire for accuracy of observation and precision of statement. Man, unscientific man, is often content with the nearly and the almost: Nature never is, and too often it is in the neglect of this golden rule failure lurks.

"It may truthfully be said that Lister created anew the art of

healing. Through the long centuries surgery has been improving and developing. Enormous strides had been made in the knowledge of anatomy, physiology, and pathology and it is obvious that, as the standard of these reached a higher level, surgical art benefited in respect to diagnosis, and in the explanation of symptoms and clinical signs. In fact, there were men of Lister's time, high in the standing of their profession, who were fully satisfied with the existing state of affairs. Tilanus, Professor of Surgery in Amsterdam, presiding in 1840 at a meeting for the advancement of surgical knowledge, said: 'Surgical art is at present within measurable distance of being perfect.'"

Following Lister, especially in America, came the fad for washings, irrigations, and packs with antiseptic solutions. Rubber tubes, wicks, and drains were put in and rivers of bichloride, permanganate, and other antiseptics began to flow. The Carrel-Dakin method, the latest and perhaps the last, the most highly technical and the best of the irrigation methods, has suffered in a manner similar to Listerism from enthusiastic but inefficient followers. Just as followers of Lister departed from his teachings and misapplied his methods, so have our modern Carrel-Dakinites applied Dakin packs, poultices, and fomentations to wounds only to have them become ineffective and even harmful in a short time because they comply with none of the technical requirements of the originators of the method.

In so far as wound treatment is concerned, the period from Lister to the Great War was devoted to a search for the ideal antiseptic; that is to say, an antiseptic that might inhibit germ growth without damaging the tissues. It is hardly necessary to say that the search has failed. Not only so, but, as has been pointed out, the attempts to sterilize and disinfect wounds have led to undue disturbance and infection, loss of position in fractures, num-

berless contracture deformities, and disability beyond computation.

As suggested also, in the discussion so far, the difficulties of wound treatment have nowhere been so great nor so apparently insuperable as in dealing with compound fractures. In acute and chronic osteomyelitis likewise, however, there has been great difficulty because of our attempts to employ the antiseptic method. This difficulty has been greatly increased by reason of the fact that early diagnosis is usually not made in the acute stage, and early adequate drainage is only occasionally employed. For these reasons the results of surgical treatment in general in acute osteomyelitis have been very bad. For those patients who recover and develop sequestrum, multiple sinuses, and other sequelæ, further drainage and the antiseptic method as employed for compound fractures have commonly been the only resources of treatment. In this, on the whole, the results have been, if anything, somewhat worse than those obtained in dealing with compound fractures by similar methods.

Not satisfied with our defeat in the wound, we have in recent years carried our methods of chemical antisepsis even into the blood stream, and with no more success than we had in the wound itself. In recent years we have had a very extensive literature on the subject of osteomyelitis as distinguished from the bone infections of compound fractures. One of the points in our discussion this evening is that these bone infections, whether of acute or chronic osteomyelitis or as complications and sequelæ of fractures, should all be treated by the same principles of surgery. This may be illustrated in the matter of drainage alone. We have all been taught the importance of drainage in any deep-seated infection, and yet in acute osteomyelitis with infection in the medulla

of the long bones drainage has usually stopped at an incision of the periosteum. In compound fractures, instead of permitting adequate drainage with an open wound, the custom has been to suture, cover up, plug openings with drainage tubes, and dressings, and in other ways to prevent the escape of those infected exudates which should be allowed easy escape from the cavity.

Errors in diagnosis in acute osteomyelitis are all too common, the patients being treated quite frequently for rheumatism, acute arthritis or neuritis. The primary infection, unless at least partially drained, leads often to fatal septic metastasis or septicemia; but when the patient does survive there is a long course of severe infection with many disagreeable complications. Drainage with frequent dressings, even when the patient's life is saved by this surgical procedure, usually leads to mixed infection, septicemia, extensive death of bone, chronic sinus, deformity, and disability. These are the results that may be avoided by an adoption of the plan for treatment which is proposed in this address. We all know the bad results that have been common with the ordinary drainage and antiseptic treatment. Professor Kuster of Marburg[113] read a paper on the results of early operation in osteomyelitis some years ago in which he reported twenty-four cases, in fourteen of which patients were operated upon during the second week of the disease. Of these only nine recovered. Of three patients operated upon in the third week, two died. In the following week, the patients, having survived the acute infection on their own account, gave better results after operation. But this is fairly typical of the general experience. The death rate in acute osteomyelitis, whether operated upon early or late, has been high.

Among those during the antiseptic era who were giv-

ing consideration to what may be called conservative methods of drainage and antiseptic dressings, there have always been some who were getting better results than the average practitioner. It seems now that these were the men who adhered most closely to the principles laid down by Lister himself.

Since I became interested in the treatment of these conditions by what I have called "the principle of rest," my attention has been directed by Dr. John Ridlon of Chicago to his memories of the Lister method as first introduced in New York. Dr. Ridlon says that, although frequent dressings were done, the wound surface was very carefully let alone, and that the type of dressing employed by Lister conformed quite closely to some of the splints that are favored by orthopedic surgeons at the present time. Dr. Ridlon recalls that the beeswax dressing, impregnated as it was with carbolic acid, was put on in a sufficient number of layers and bandaged in such a way as to constitute a splint in many of these conditions. The wound surface having been covered with oiled silk, and the antiseptic kept outside of that and the beeswax dressing of many layers bandaged over a compound fracture, for example, there resulted a non-irritating, immobilizing dressing that was very helpful in these cases.

Among those who followed Lister rather more closely than the average in these respects was Dr. F. S. Dennis of New York. In 1884 he reported a series of compound fractures with a high percentage of recoveries.[49] Some of these were fractures of the skull and of the jaw. If we select those which more nearly illustrate the point we now desire to discuss, we find that he had sixty-one cases of compound fracture of the leg and of the thigh.

Dr. Dennis has shown us in many ways that he was a

surgeon of exceptional skill and industry. In these compound fracture cases he not only did what we now call primary debridement and employed antiseptics in his preliminary operation, but he placed the injured limbs in plaster-of-Paris casts as an immobilizing dressing. His instructions to his ambulance surgeons were that these patients were to be irrigated with antiseptics and dressed before being lifted into the ambulance from the place of injury. Of the sixty-one cases which Dr. Dennis reported in this manner three patients died, twelve were amputated, and five had been under treatment for less than one month at the time of making his report. This gives us forty-one cases in which we know patients recovered.

In applying the plaster-of-Paris casts Dr. Dennis left large windows with the wounds entirely open so that when the wounds suppurated, as they usually did, the drainage was allowed to flow freely out of the wound and out of the window in the cast without any interference by pads, packs, tubes, or dressings. It was Dr. Dennis' opinion that a freely suppurating surface was a better protection for the patient against the invasion of new infection than dressings in the manner that was then employed. If the granulations were weak and flabby he employed flaxseed and carbolic poultices and afterward stimulating dressings such as Balsam of Peru, iodoform, bismuth, and oxide of zinc. Around the edges of the window in the cast he packed cotton which was changed as occasion required. The limb in the cast was suspended in a Flührer swing, a device not very different from our modern Balkan frame. Frequent changes in the cast were made as seemed to be necessary on account of swelling or inflammatory complications. It is quite apparent that Dr. Dennis maintained for his patients a

much more efficient plan of immobilization than the average surgeon even of the present time. It seems to me that this had more to do than anything else with his rather remarkable success in such cases. We have observed that immobilization, even in the presence of active infection and suppurating wounds, will contribute much to the union of fractures and the healing of the wounds themselves. This was a point which was frequently emphasized by the present writer in dealing with compound fracture patients who in 1918 were being dressed for transportation from France to the United States.

Before the introduction of the Lister antiseptic treatment, the death rate in compound fractures was reported to be all the way from 26 to 68 per cent. In a later report in 1886, Dennis reported a series of 500 cases with still no deaths from septic infection. It is important to observe, however, that the percentage of amputations in Dennis' cases was very high. From reading the details of some of his individual cases one must infer also that disability and deformity were of rather frequent occurrence. It is to this phase of the topic, also, that we desire to address ourselves upon this occasion. If we are able to show, as I think we can, that adequate splinting and protection of the wound are the matters of primary importance, rather than provision for dressings regardless of the fracture, we shall then be in a position to urge all of our surgeons to make that definite provision for position, traction, and immobilization which are the fundamentals of fracture treatment. And the primary dressing of the fracture to which the surgeon can apply his best experience and skill may be just as good as he knows how to make it and be made permanent at the same time

If we can feel assured that a compound fracture can be put up in a splint of plaster without having to plan

for changes on account of drainage, irrigation tubes, wet antiseptic pads or for any other purposes of that sort, we may arrange the parts in such a manner that, good position having been obtained, it will be maintained until opportunity for union of the fracture has been afforded.

This is just the sort of thing that we have not heretofore felt able to do; if we may now change our tactics so as to center all of our plans upon the matter of adequate splinting, there is not much doubt that better results in fractures of all kinds will be obtained. That is to say, if a large wound may be left open and provided with drainage and still dealt with in the same manner as a primary closure in these fracture cases, we shall have made provision for a kind of healing, both of the fracture and the wound, that heretofore we have not been able to obtain. Secondary dressings and secondary infectious complications, as well as loss of length and of position and the occurrence of deformity, will all have been provided against, and a good result will be the natural consequence.

During the last war, and even for some years preceding, a good deal of emphasis was placed upon the importance of giving compound fractures and joint injuries with small wounds a chance to heal without disturbing the wound either primarily or secondarily. The comparatively recent custom of probing bullet wounds to locate the foreign body was frowned upon, and penetrating joint wounds were more often let alone unless signs of inflammation appeared. The rather frequent prompt healing of such injuries was ascribed to the supposed fortunate circumstance that not much infection had been introduced. It was rarely suggested that the tissues having been spared additional damage by operation on secondardy dressings were able to resist the infection in-

troduced, no matter what the amount. That the tissues might equally meet the emergency in larger wounds if the tissues were treated with similar consideration had apparently not been thought of, or, if so, the idea had not been made the basis of any plan of treatment. Those who followed Hunter and Lister in any attempts to secure healing "under the crust" were far too much inclined to experiment with chemical antiseptics applied to the wound surface to permit the natural defenses a chance to show what they could do.

One conception of both patients and surgeons that has often led us into error is that every major injury and major infection presents a problem which is individual to the particular patient and for which a solution must be found by the individual surgeon. This feature is discussed by Schimmelbush[190] as follows:

"With the various forms of injury it is impossible to lay down fixed general rules applicable through a whole course of treatment. Every case requires its particular plan, every plan its particular method of execution. One point, however, now permits definite decision and makes an important difference in the treatment to be adopted, that is, whether we have to deal with an injury comprising a large wound, or a lesion of small proportions. The prognosis of the latter as regards the danger of infection is most favorable if we take heed of its subcutaneous character and maintain the latter state by covering the puncture with a simple dressing after the disinfection of the skin in the vicinity. . . . To this class of injuries belong complicated fractures with small cutaneous wounds, and those in which there is moderate protrusion of the fragments, and especially the gunshot injuries produced by our modern small caliber weapons. Von Volkmann announced before the German Conference of Surgeons in 1871 and 1872, as a result of his experience in the war of 1866 and 1870, that these injuries run the most favorable course when we refrain from all radical surgical procedures, incision, drainage, etc.; simply apply an occlusion dressing and treat the wound as subcutaneous. It was with this principle of

the aseptic occlusive dressing that von Bergmann and his assistant, Reyher, obtained such brilliant results in the Russo-Turkish War. We must admit that in the case of a compound fracture, pathogenic organisms may obtain entrance to the wound along the protruding spicula of bone even through the medium of the bullet. But it is a fact that under the occlusive dressing an unfavorable result has seldom been seen. Almost invariably these injuries run a course unattended by reaction, in case of a gunshot wound the missile becoming quietly encapsulated. In the hospital of a city with the population of a million, gunshot injuries and compound fractures are by no means rare, and still in the von Bergmann clinic we cannot recall an instance in which a simple gunshot wound or fracture with small external opening had not healed properly under the aseptic occlusive dressing. In the battle of Groni Dubnik of the Russo-Turkish war, von Bergmann selected, from a number of cases of gunshot injury to the knee, fifteen of the most serious, in which, aside from the opening of the knee joint, there was extensive comminution of the bone. These patients were treated with the aseptic occlusive dressing after a disinfection of the skin in the region of the wound, salicylic gauze being applied and the limb immobilized in plaster-of-Paris, and with but a single exception perfect recovery took place, notwithstanding the fact that the patients were exposed for days to pouring rain, and had to be transported across plains over muddy roads."

But Schimmelbush does not conclude from this, as I think we should, that rules may be made which are universally applicable in the treatment of fractures and infections, and that if apparent exceptions occur it is because other conditions have arisen for which, as we become wiser, other rules must also be made. For example, in the method I now advocate there is what may be called an occlusive dressing for large wounds which excludes infection but permits drainage.

In the field we speak of as aseptic surgery, the teachings of Lister have been excellently applied. Except in the hands of inexperienced and unqualified surgeons our clean operations are really clean and primary healing is

the rule. In the field of antiseptic surgery, however, the story is an entirely different one. If an operative wound becomes infected, or if we have to do with a septic wound from the beginning, even the best surgeons or their assistants have carried into the wounds every variety of secondary or mixed infection under the pretext of doing antiseptic dressings. The infected wound requires protection, no less than the primary aseptic one, from soiled fingers, instruments, and dressings, a rule that up to now has been honored far more in the breach than in the observance.

One of the most impressive features of the work of orthopedic surgeons along the lines already described has been the avoidance of postoperative complications following bone and joint operations. In our own operations for mal-union and non-union of fractures, strict immobilization and the avoidance of postoperative dressings is the rule. This rule is adhered to even in those occasional instances in which moderate rise of temperature and increased leukocyte count comes on a few days after operation. It is found that practically all of these reactions subside within a day or two if nothing is done. If casts are removed, on the contrary, and dressings are done, a suppurative course is almost certain to follow, often with breakdown of the operative wound and loss of position of the fracture. If definite postoperative infection does occur, a simple dressing with drainage through a window in the cast and without actual disturbance of the wound or the part will almost always relieve the condition. One case will illustrate:

M. F., age 21, sustained a compound fracture of the leg August 12, 1928. After three months the wound had healed but there was non-union of the tibia and fibula. Open operation was performed on November 19. A heavy slide bone graft was placed across the area of fracture and fastened in position with two

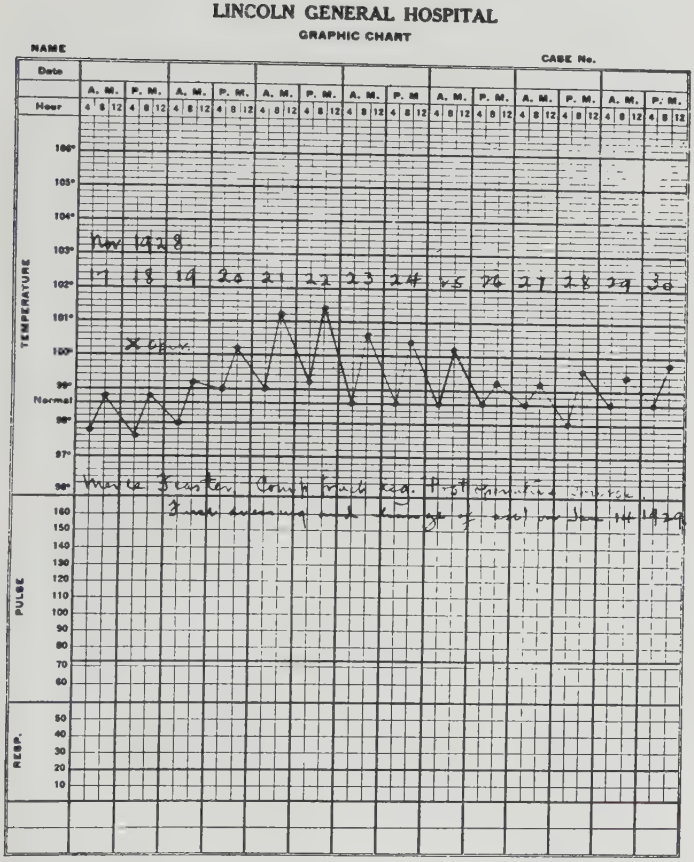

Fig. 5. The above chart shows the rise of temperature that frequently follows compound fracture or operation, and that is usually taken as an indication for removal of cast, irrigations with antiseptics, etc. In this case (M. F.) no dressing was done, cast was not disturbed and prompt healing of wound and fracture was obtained.

pins. The outer ends of the pins were included in the cast. An interesting point in this case was the fact that there was a moderate temperature reaction during the first ten days that subsided without any serious damage. There was in fact enough infection to cause a small sequestrum to form in the area of the bone graft, but this was not dressed or disturbed until two months after the operation and good union was obtained with no loss of position or any important inflammatory complication.

It is in situations like this that ordinarily we throw our results to the winds by the manner in which we institute supposedly necessary antiseptic wound treatment. In this case the pins and a small sequestrum were taken out and an excellent result obtained with a single change of dressing and cast two months after operation.

The manner in which we clung to the hope that the active antiseptic method as practiced for fifty years might yet carry us out of our difficulties in the management of septic wounds, is indicated by the following remarks quoted from Dr. W. W. Keen:[108]

"Early experiences in the war demonstrated the fact that both antisepsis and asepsis as heretofore practiced had been vanquished by Mars. Each was tried and each failed. It was even proclaimed that Lister's work went for naught. Now, however, antisepsis and asepsis (in its proper place) have come into their own again, and Lister is still the apostle of good tidings. The reasons are plain: first, we did not possess sufficiently effective antiseptics, such as modern research has now given us; second, we were not masters of an effective and successful technic. We owe these especially to two men—Dakin and Carrel—who have wrought a marvelous revolution.

"Lister taught us above all how to *prevent* infection: Dakin and Carrel, following Lister's principles, have taught us how to *conquer* even rampant infection. For nearly half a century we surgeons have been fighting firm-intrenched infection, but always in vain. It required the stern stimulus of war to enable us to win the victory. Prevention and cure both are now ours."

In a few years, however, it has become a matter of history that even with an antiseptic technic as carefully

worked out as the Carrel-Dakin method there was still so much disturbance of parts, so much damage to the wound surface and so many accidental secondary infections—in other words, that in actual practice it differed so little from all other antiseptic methods—that it was unsuitable for general employment by the profession.

There is no doubt that there were thousands of surgeons who felt as Dr. Keen did, that the war had made a great contribution to the progress and efficiency of antiseptic surgery. Some of us, however, did not feel that way. To describe further the exact status of antiseptic surgery just previous to and during the war period I shall continue our discussion of what we may call "the antiseptic era" with several more quotations. Some of these indicate a change of emphasis as well as of technic that may be said to herald the approach of the new era. First let me read you the following extract[117] and challenge you to tell, if you can, at just what time it was written.

"In conclusion I would express the opinion that the treatment most likely to give the best results is the one in which operative interference is the smallest possible. Free incision, immediate excision of tissues badly damaged, whether by violence or by soiling, drainage of pockets without packing of the wound, the removal of as little as possible of fragmented bone, the suture of bone or muscle in clean wounds only and with amplest drainage, may in appropriate cases supplement the most thorough and painstaking mechanical cleansing of the wound. I have not seen medicated solutions or dressings at this time followed by any better results than the use of sterile gauze. For irrigations I believe a physiological salt solution to be as efficient as any other, and less liable to do further harm to bruised and partly devitalized tissue. What bacteria remain in the wound after thorough mechanical cleansing cannot be reached by antiseptic solutions or dressings, for they are probably embedded in tissue and inaccessible to germicides, without damaging vital tissue. The limb should be put in proper apparatus; that one being the best to use in that particular case, with which the operator is most familiar

in simple fractures. During the next few hours and days careful watch for the occurrence of symptoms of inflammation should be kept up, and at their advent there should be no delay in inspecting the wound and taking what further measures the individual case may require.

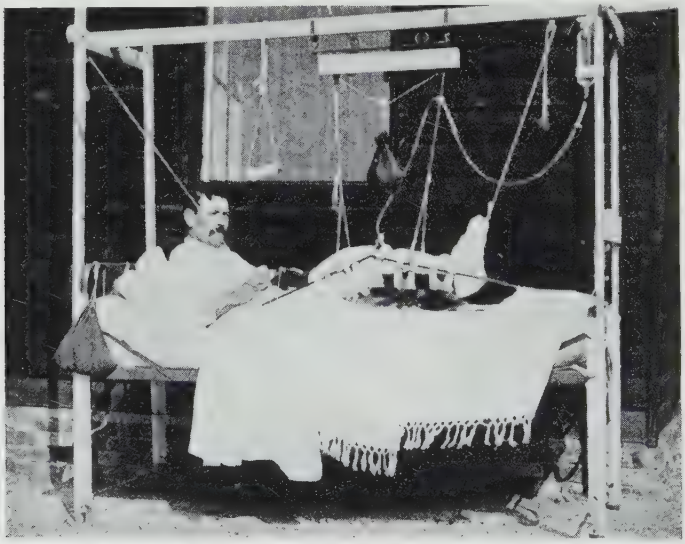

Fig. 6. Reproduced from article by H. H. M. Lyle, Annals of Surgery, June, 1920. This particular apparatus was designed by Dr. Lyle. None of these elastic weight and pulley suspension and traction devices afford adequate immobilization in compound fractures with inflammatory complications (osteomyelitis), but they have been generally considered to be necessary to permit frequent dressings.

"Where free incisions are made, at the primary dressings, the circulation of the wound is less embarrassed by the swelling so apt to occur as a result of traumatism, and the tissues are better able to protect themselves from harmful influences of bacterial multiplication, as they are better nourished. Absorption of toxic products is also likely to occur, and give rise to severe constitutional symptoms."

Le Boutillier[117] reported results in his own cases as follows: Infection occurred seventeen times, was mild in six cases, severe or moderate with recovery in four, led to six amputations with one death, and one death without amputation. He says further:

"I have not computed the time necessary for union to take place in these compound fractures, and have paid no attention to the resulting deformity."

This comment is of especial interest. I am sure that most of you will feel that this must have been written during the Great War and you will be surprised to learn, as I was, that it was written twenty years before—in 1899.

Since the war the following was written as a recommendation for a new device to be employed in the treatment of compound fractures. In this we see again the departure from the teachings and the spirit of Lister's antiseptic method of many years before.

"The advantage is ready accessibility without disturbance of apposition. The dressing can be changed by the nurse as often as desired. The presence of the doctor to readjust splints is not necessary."

To what this leads in actual practice I need not remind you. It would seem that the success of the Lister method should have led us earlier and more completely to depend upon the natural defenses of the body to take care of certain amounts of infection. It is quite obvious that Lister's method could do no more than to exclude a certain amount and not all of the infection. If Lister's immediate followers had concentrated as he did upon the problem of excluding infection rather than upon that of attempting to sterilize the wound, or clean up infection by means of antiseptics, it seems quite certain that we should have progressed further than we have in dealing with these conditions.

The time may come, of course, when we shall have methods for measuring the amount or the virulence of infections and our capacity for resistance. Until that time it seems important for us to adopt every expedient that offers to close the avenues by which infection may get into our bodies and to increase our resistance by all the methods with which we are familiar.

One of the important points to bear in mind in connection with Lister's contribution to surgery is that while all of his work was done around a single point—namely, the exclusion of septic organisms from wounds—he had not failed to be impressed with the importance of the employment of rest in surgery also. It may be said that if the ancients had possessed the information to enable them to keep infection out of wounds, their methods of rest would have been sufficient to secure the same excellent results that Lister obtained.

It is because of a mistaken enthusiasm of Lister's followers for antiseptics rather than for Listerism proper that many of our failures since that time have arisen. In recent years we have concentrated upon the antiseptic treatment and this has led us to disregard much that we had learned even prior to Lister's time about the importance of rest. A great deal of the energy, time, and expense devoted to the development and perfection of antiseptic substances has only served to lead us away from these well recognized principles of treatment. In other words, the desired results may be arrived at by much simpler methods and devices than those we have been employing and in the effort to employ these more complicated chemicals and clinical methods we have been distracted from the simpler and better ones. It seems as though we might have forgotten an injunction as old as Hippocrates: "The first duty of the surgeon is to do his patient no harm."

Surgical traditions arising before and after Lister have given us methods both simple and complex. We must learn to select what will serve us best. Our own conclusion is that we must achieve rest and exclusion of infection from wounds by the simplest and most efficient methods and not by the most complicated and most difficult ones.

There were many writers, to be sure, who referred to this phase of the problem and who were encouraging us to keep out fingers, instruments, dressings, and drainage tubes, which served rather to carry infection into the wounds than to assist the wound in throwing off infection. In 1910 Professor Reverdin[175] reminded us in discussing military injuries that we should make more extensive use of our natural defenses against infectious wound complications. Professor Reverdin spoke as follows:

"De ce que nous venons de voir, on peut tirer les conclusions suivantes:

"1. Les plaies par balles sont forcement infectees par l'introduction des microbes de la peau.

"2. Elles le sont frequemment par les microbes contenus dans les debris vestimentaires et qui penetrent presque toujours dans la plaie.

"3. Le projectile lui-meme ne parait jouer ordinairement qu'un role secondaire; il peut cependant parfois ensemencer la plaie avec certains microbes (charbon, tetanos).

"4. Un plaie par balle ne peut donc jamais etre aseptique.

"5. Malgre ce defaut d'asepsie, les plaies par balles sont susceptibles de guerir sans accidents infectieux.

"Cette contradiction apparente s'explique par le fait bien connu que l'organisme sain est armé pour combattre et detruire les micro-organism qui l'ont penetre, a condition que le nombre et la virulence de ceux-ci ne soit pas trop grands. Nous pouvons donc dire que si l'infection suppurative ne se produit pas, c'est que la quantité et la virulence des microbes qui ont penetre dans

les tissus sont telles que la phagocytose est suffisante pour detruire."

The professional custom, if so it may be called, of placing wound treatment first and fracture treatment second, is one which has involved us in many of our difficulties in dealing with this class of cases. The point is often lost sight of in replacing the fragments in any fracture, whether simple or compound, that the replacement of the injured soft parts with the restoration of circulation and nerve supply is often quite as important both for immediate and for the ultimate result as the setting of the fracture. One of my principal reasons for asking that we do away with active antiseptic treatment is that in such treatment there is too much disturbance both of the injured parts as a whole, and of the wound surface as well. That the old attitude of surgeons generally in this regard did not change during the Great War is indicated by the following:†

"The treatment of a compound fracture must be divided into two parts: (a) the cleansing of the wound; (b) the setting or reduction of the fracture, followed by its maintenance in good position. In the early stages the first is by far the most important, and on its attainment depends, within limits, the success of the second.

"Total immediate reduction is good and to be aimed at, provided it can be carried out without prejudice to the cleansing of the wound, but incomplete reduction, or even no reduction at all, may be advantageous by aiding the disinfection of the wound. Surgeons working at the front are therefore mainly concerned with the primary cleansing of the wound and with the means to transport to the base with comfort and without detriment to the wounded limb."

It is my contention that, on the contrary, immediate "reduction" of the fracture and the adjacent soft parts

†Bowlby and Wallace: Abstracts of War Surgery, p. 44. See bibliography, reference 1.

and adequate immobilization of all the parts in correct position are the primary essentials in compound as in simple fractures. In fact, not even debridement or drainage operations should be done until such reduction and immobilization have been accomplished. Then, with the parts in correct position and at rest, the operation required may be carried through with a minimum of further damage, and without any further change or loss of position the immobilizing device which is to carry the patient through to recovery may be put on.

The "bismuth paste" methods of Beck and Morison were early signs pointing in the direction of the new era in the treatment of osteomyelitis. They had already led us to a considerable modification of antiseptic wound technic when the apparent breakdown of all antiseptic methods led to their general rejection. There were also a few cases of bismuth poisoning to suggest again the inadvisability of direct chemical applications to wound surfaces. Custom bound us, however, to the use of chemical antiseptics in the wounds and usually frequent dressings. The suggestions of both Beck and Morison are entitled to the greatest respect because they served to remind us of Lister's teachings as to the importance of bacterial exclusion. Now we have found that a non-antiseptic mass will serve as well to keep out infection and that immobilization and protection for long periods may be added to contribute to the patient's comfort and recovery.

The "Bipp" method of Morison was described[238] as follows:

"The *bismuth paste treatment* gives remarkable success in cases of wounds which are not associated with deep cellulitis. In the case of a ragged deep lacerated wound, the patient is given a general anesthetic; the skin is sterilized; the wound is freely opened so as to expose all of its recesses, all bleeding is

checked and all foreign matter is removed; the wound is thoroughly washed with hypochlorite solution, followed by normal salt solution, or, better, it is simply mopped out with a paste of bismuth subnitrate (1 part), iodoform (1 or 2 parts), and enough liquid paraffin to make a thick paste, having the consistency of soft butter.

"The paste is spread over the wound surface and made to fill every crevice. Over the wound a dry gauze dressing is applied and held in position by adhesive plaster and bandage. No change of dressing is required for several days or a week. The dressing may remain sometimes two or three weeks without changing, the discharge should be wiped from the skin with alcohol, some more of the paste applied to the skin, and a fresh covering of gauze put on. This is the method of R. Morison. The paste is called 'Bipp.'"

As an indication of the feeling of uncertainty that still prevailed, however, Warbasse[238] published the following instructions regarding flavine and eusol, in the same chapter:

"The antiseptic treatment of infected wounds is aimed to introduce substances which directly destroy bacteria. For most infected wounds the treatment with normal salt and hypertonic solutions is to be preferred. But in badly infected wounds with much bacterial growth, in which accessible bacteria may be washed out of the wound, antiseptic fluids may be employed. These substances may be used alone or alternating with the physiological treatment.

"When a soiled and infected wound comes to the surgeon, it should be cleansed of foreign matter. If dried discharges and coagulated lymph are present they may be softened by applying copious hot, wet dressings of hypertonic salt solution for an hour. This cleans the wound. The wound may then be irrigated with the antiseptic solution, and then exposed to the sun or electric light. If the infection is virulent and the discharge profuse, continuous irrigation is to be preferred."

Even at the present time, new substances are being heralded as the final and most perfect chemicals for antiseptic wound treatment, but until we can poison the

germs without poisoning the tissues, traumatize the wound surface without injuring the patient, and disturb the injured part without interfering with position for fracture repair, present methods of antiseptic wound treatment will do more harm than good.

Indications and Requirements of the New Era

In the above references are found a considerable number of the suggestions and methods that indicate the approach of a new era in the treatment of wounds. The suggestions of Beck and Morison as well as a number of others before the war period indicated a trend away from the antiseptic method and toward the new era. The modification of the Lister method already described and our experience during the Great War were quite sufficient to indicate that satisfactory results with the antiseptic method for infected wounds were not being obtained.

In compound fractures as well as in other forms of osteomyelitis it was plain that much damage was being done by the over-zealous use of complicated technical methods. Adequate drainage had been sufficiently urged and by all of our best surgeons was being properly employed. The Carrel-Dakin method was offered during the early part of the war as a solution of the difficulties that had been experienced in the employment of active antisepsis. This highly technical method certainly had the effect of cleaning up wounds and saving lives. As a method of active antisepsis the Carrel-Dakin method justified itself even in spite of its technical difficulty. To one trained in orthopedic surgery, however, the experience of this entire period indicated that the principle of rest was being disregarded to too great an extent in this method as well as in some of the less efficient methods

of the employment of antiseptic solutions, and in actual practice they all violated the teachings of Lister.

It seemed to those of us who were trying to get away from the disturbance of wounds and injured and inflamed parts that immobilization and protection of the wound surface are factors in treatment that must have first consideration after drainage has been provided. For this purpose none of the splints employed during the war period had proven to be adequate; for one reason all the splints in use had been devised and were being applied in such a way that access to the wound was made paramount to true immobilization. Plaster-of-Paris had already demonstrated itself to be more highly efficient than any other agent at our command.

One of the most striking and most important steps taken in the direction away from the antiseptic method was the more extensive adoption during the war period of the method of primary closure. It had long been known that certain types of compound fractures might be dressed in splints and permitted to heal primarily, just like simple fractures. It had been assumed that in these cases little or no infection had been introduced, and that therefore, antiseptic treatment could be omitted. From this to the method of debridement and primary closure was a short step and a considerable number of successful cases began to be reported.

Wallace and Fraser[235] in their book on war surgery referred to this in the following words:

"When these cases came to be dealt with in 1914 and the early months of 1915, it was felt every reliance must be placed on the natural resistance of the human body and of the germicidal action of powerful antiseptics. Experience soon showed that these factors were insufficient and new principles of treatment were adopted which have effected a great improvement in the results of these cases. The underlying features of a successful

treatment are, first, keep the main portions of the injured bone in correct position; second, to remove all infected foreign bodies as far as possible, all grossly infected tissues; third, to counteract any infection which has already occurred and to prevent fresh infection."

Mr. Hey-Groves at that time was insisting strongly upon the importance of immobilization of fractures. He, as well as the rest of us, however, was thoroughly committed to the necessity of immobilizing with such devices and methods as would enable us to make frequent changes and dressings in these cases. Mr. Hey-Groves[235] among other things said:

"First, the limb must be so placed that the wound can be frequently dressed," and "the wound must further be treated by frequently repeated or continuous methods which remove septic discharges and restore it to healthy character."

It is from this position that we make our departure in the Orr method of treatment. We do not try to "counteract any infection which has already occurred" or arrange the parts and the splint so that we can "make frequent changes and dressings" or employ "frequently repeated or continuous methods which remove septic discharges," having shown that these things are not only unnecessary but harmful. Neither primary nor secondary closure are appropriate or suitable for a large percentage of compound fractures, and seldom or never, for osteomyelitis. One of the points particularly emphasized in the method which has been associated with my name is that pockets of pus or infection should never be covered over so as to become enclosed and make trouble later on. What we have done in our method is to take the next step for wounds that obviously cannot be closed by primary methods and perform what may be called an artificial closure of a septic wound by a sterile non-absorbent pack that permits healing from the bottom toward the

surface without enclosing infection or interfering with drainage until healing has occurred. In our own experiments, therefore, to find a more satisfactory method of treatment than by active antiseptics, we continue to use plaster-of-Paris,taking more pains than before to apply efficient, well fitting comfortable casts. Those who have objected to the use of plaster-of-Paris commonly urged that there is too much difficulty in their proper application and that they do not permit easy and frequent dressing of wounds. The only answer to these objections is to be found in the application of well fitting good casts and by doing no dressing. By employing such methods we found that our patients were doing better, not only as to the fractures but in respect to the wounds as well. From this point gradual progress has been made in the development of our method which is to be described.

The adoption of primary closure of infected wounds as a routine procedure in some clinics indicates the anxiety that many operators felt to get away from the antiseptic treatment of wounds. There were, of course, a considerable number of brilliant successes; at the same time there were numerous failures and even some tragedies. We all felt that many of the attempts at primary closure might have been more successful if they had been closed with drainage. This sounds like a paradox, yet the statement has a certain significance that I shall explain. In the method of treatment for osteomyelitis and compound fractures that I have devised we employ a method that is really primary closure by aseptic vaselin packs which remain in place and are not removed. In this way we have an artificial primary closure with an opportunity for the escape of whatever discharges there may be from the wound. It is quite possible that in some of these cases closure might successfully be made by suture, but

I shall show presently why I prefer gradual closure by granulation.

These extensive modifications and experiments with the antiseptic method that have been described as well as the attempts to employ primary and secondary closure, indicate the effort that was made to improve upon the antiseptic or Lister method.

In spite of all the attempts that had been made to improve upon the antiseptic method and in spite of Bipp, the non-antiseptic salt packs of Wright, and primary and secondary closure—advance indications of a new era in the treatment of local and general infections—the end of the Great War found us still without an effective method of dealing with compound fractures and osteomyelitis.

Of the other suggestions being made that indicate the approach of a new era attention should be given to the experiments and experiences of those who have been working with the bacteriophage. D'Herelle, Twort, and others have been endeavoring to apply the observation that certain bacterial growths and cultures appear to have the property of sterilizing themselves. It has been known for some time that certain culture tubes in the laboratory, certain agar plates, and even certain growths of bacteria in water and other solutions, if allowed to multiply indefinitely, become sterile. These recent observers have pointed out, however, that apparently there is present in such cultures another growing agent, one which will pass through filters and which seems to be an ultra microbe. It has been called the bacteriophage. D'Herelle believes that these organisms are 2,000 times smaller than the known bacteria. He believes that they are parasites of known micro-organisms and possibly parasitic to them all. The bacteriophage has apparently been isolated for use in typhoid fever and dysentery and pos-

sibly for some other acute infections. Unless this is the change which takes place in the wounds treated by the method described by the present author, however, no method has so far been devised for the employment of this agent in the treatment of infected wounds.

Dr. W. S. Baer of Baltimore has recently suggested the employment of macroscopic scavengers working alone or along with the bacteriophage to clean up soiled and septic wounds. He has employed specially cultured and, one might say, almost specially trained, maggots. These maggots are grown and planted in the wounds under certain conditions at certain intervals. The idea is to have them consume or destroy dead tissue and thus avoid putrefaction and decomposition of such tissues in the wound. If the development of septic micro-organisms can be prevented in this manner, Dr. Baer's method must, of course, have proper consideration.

From the preceding pages we may gather that various observers and experimenters have directed their efforts toward bringing about a new era in the treatment of these infected wounds: Wright, Morison, Beck, Schimmelbush, and others have all made suggestions looking toward the aseptic rather than the antiseptic method in dealing with wounds.

My own experience has led me to adopt what is essentially the same point of view, and it is a set of suggestions regarding treatment without antiseptics that I shall present for your consideration.

The method, as may be explained in a few words, rests upon two or three principal factors. First of all, my training as an orthopedic surgeon and especially the influence of my teacher, Dr. John Ridlon, of Chicago, led me to the belief that not enough immobilization and protection were being afforded to inflamed and injured

parts. In the second place, I think, we all found ourselves somewhat disturbed by the teaching and practice of the war period with regard to wound infections, especially in connection with compound fractures. Those of us who believed in the principle of re-position of fracture fragments and immobilization during the period of healing found ourselves with splints and casts all set aside in the supposed interest of wound treatment. In addition we had enthusiastic leaders who proposed almost complete abolition of immobilization in fracture and joint injuries, some of them even going so far as to advocate early motion in compound fractures infected and involving joints. It was extremes like this that led some of us into the position of revolt.

Having been convinced by this experience that antiseptic methods were doing more harm than good I not only continued my previous practice with regard to the application of plaster-of-Paris in all of these conditions, but began to find it possible more and more to disregard the wound and customary wound treatment. From small beginnings in 1921 and 1922 to the present time we have found ourselves able to treat these patients by immobilization and rest both for the injured part and for the wound itself, and with increasing success in every particular. For the most part we have been able to forget our wounds entirely. While healing takes longer than first intention and is in some respects a somewhat more complicated histological process, our care of such wounds, even of large size and severe infection, involves us in no more anxiety than the primary healing of a clean surgical wound.

Following a descriptive outline of the method, I shall present some of the details with case reports for your consideration. The method, often called the Orr method,

is one of drainage and rest. The details are as follows:[158]

1. As a preliminary to any operative procedure we immobilize the patient on a traction table with all of the injured parts in as nearly as possible correct anatomical position. For fractures or old contracture deformities this may call for preliminary manipulative correction or skeletal traction or both. The patient is so arranged that, good position having been obtained, the operation may be carried through and plaster-of-Paris applied without motion of the injured or inflamed parts, and so that the position obtained will not be disturbed in any way during the postoperative care.

2. The entire infected area is opened up and drained by suitable operation. Foreign material and dead or dying tissue are removed. As part of the debridement or drainage operation the wound may be wiped out at the end with iodin (pure tincture) and alcohol, or some other efficient antiseptic.

3. Protection of the wound and permanent drainage are provided at the same time by a non-absorbent, non-irritating vaselin pack which will keep open all parts of the wound. No drainage tubes are used, and no parts of the wound covered up by flaps, sutures, or other devices.

The vaselin pack must not only be carried to the depth of the wound, but it must flow over the edges at the top to a distance of an inch or so around the wound, and the wound dressing completed by a dry sterile absorbent pad bandaged firmly over the entire area.

4. The affected part is enclosed in a well fitting plaster-of-Paris cast, or some other efficient immobilizing device. In case of fractures or other conditions in which highly efficient traction and fixation are desired, moleskin

adhesive plaster, ice tongs, Steinman pins, or pins directly into the fracture fragments are inserted and the ends included in the cast for better control of the parts and the patient. Casts must be well fitting and sufficiently extensive to overcome, once and for all, muscle spasm and irritative motion of all kinds.

5. Finally, no postoperative dressings in the usual sense are done. If immobilizing devices become inefficient, if discharge is profuse, or if odor (because of mixed infection) becomes unendurable, dressings are changed usually in the operating room without disturbance of the part and with a minimum of damage to the wound surface.

Much has been said, and much more might be said, of our enormous debt to Lister for the influence of his discovery and of his labors in the saving of life and the mitigation of suffering. The hope that we have now is that in this new era it may be possible to add to that great work something in the direction of saving limbs especially as to deformity and disability. If it is possible, as we now think it is, to place an extremity with a compound fracture or an acute destructive bone or joint disease regardless of the size of the wound in a permanent dressing and splint at the time of operation, so that healing may take place without loss of efficiency in the apparatus or loss of position of the limb, we shall have taken a great step forward. With the methods still in common use the best position of a compound fracture that can be obtained by the skilled surgeon at the time of primary operation is quite likely to be lost because secondary dressings and postoperative care of traction and immobilizing devices are left to associates or assistants with quite different ideas or ideals regarding the objects of treatment. Loss of position and secondary infection

The Orr Method in Osteomyelitis, Compound Fractures and Other Infections

OUTLINE

1. Immobilize patient in best position on operating table.
2. Do a thorough debridement or drainage operation.
3. Pack entire wound open with vaselin gauze, using no suture or drainage tubes.
4. Apply extensive well fitting plaster-of-Paris cast.
5. Do not disturb the wound or the part except for definite complications.

PRELIMINARY

a. Secure best position possible by traction, manipulation, etc.
b. Use the simplest and least possible number of movements.
c. Employ moleskin traction, pins, or ice tongs if necessary and include them in the cast.
d. Do not move or manipulate the parts during or following the operation.

THE OPERATION

a. Make an incision or opening that will thoroughly uncover (saucerize) the infected area.
b. Remove as much foreign material and dead or dying tissue as possible.
c. Do not curette or damage healing and protective portions of the wound cavity.
d. Do not remove bony or soft parts that may contribute to repair.
e. Wipe out with iodine and alcohol.

THE CLOSURE

a. Fill entire cavity with vaseline gauze pack from the depths to the surface of the wound. Pack gently but firmly.

b. Use no drainage tubes or other mechanical irritants.

c. Use no chemicals as a dressing.

d. Do not suture or cover any infected areas with flaps.

e. Cover with a dry, sterile, absorbent pad.

THE SPLINT

a. Immobilize the affected part in such a manner that no muscle spasm or contracture can occur.

b. Plaster-of-Paris, well fitting and extensive, has been found to be most satisfactory.

c. Moleskin adhesive straps or skeletal fixation devices to be included in the cast will insure fixed traction, control of fragments in fractures and comfort for the patient.

THE DRESSING

a. Plaster-of-Paris casts are applied so as not to be fenestrated or split. In this way the temptation to inspect or dress the wound is prevented.

b. Secondary dressings, when done, should be done in the operating room and aseptically.

c. The injured part is not to be moved nor the wound surface to be damaged.

d. Do not hesitate to employ anesthetics for secondary dressings.

e. Make late dressings as infrequent as early ones.

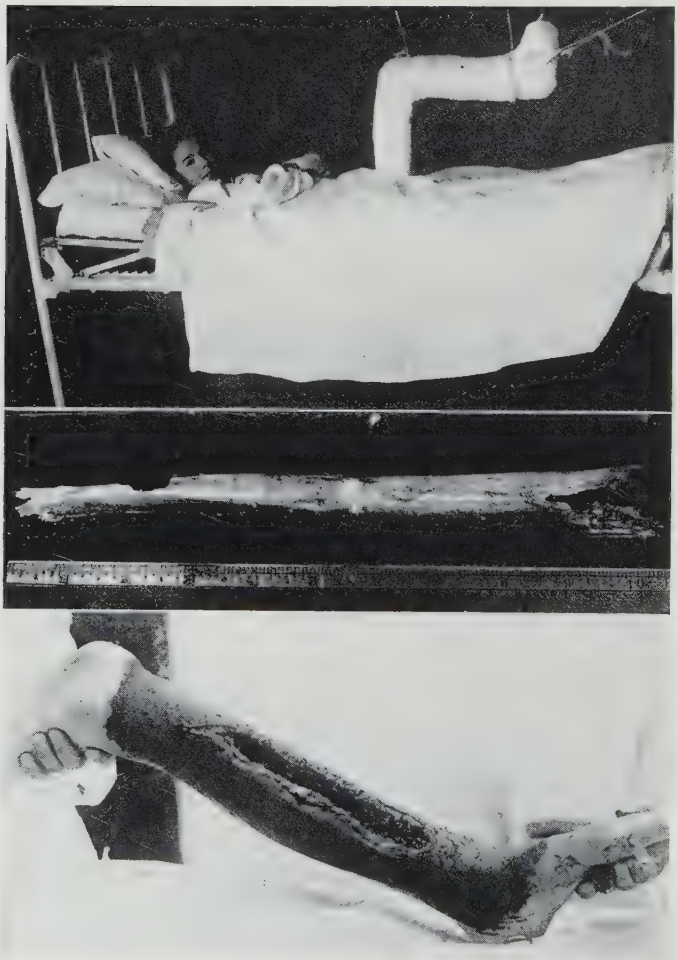

Fig. 7. Condition and position of patient in bed six weeks after removal of the large sequestrum shown just below. No dressing has been done. The lowest picture shows condition of the wound upon removal of the cast seven weeks after operation.

have therefore been the rule, and deformity and disability a common consequence.

If the original ideas of the trained surgeon can be "made permanent" by a dressing that is not to be disturbed and by position in plaster cast at the time of the operation that is not to be changed, an entirely different set of postoperative conditions and results may be assured. As a matter of fact, with the method of rest instead of active wound treatment, with skeletal traction and with plaster-of-Paris as immobilizing devices, that is exactly what can be done.

It is quite commonly objected that plaster-of-Paris is not a safe splint material in the hands of those who are not experienced in its use. Just why those same inexperienced operators should be permitted to get poor results without the use of plaster-of-Paris is not made clear. For it is well known that extremities are lost, malunited, or un-united because less than expert methods have been employed in the case of fractures. The answer should lie in the teaching, for many years, of Sir Robert Jones and others, that, after all, the care of these conditions should go more and more to special services and special men trained for first aid and after-care in fractures and traumatic surgery.

It has long been recognized that surgical drainage is a consideration of first importance in the treatment of either acute or chronic osteomyelitis. One might suppose that nothing more needs be said in regard to that part of the treatment at the present time. Strangely enough, however, a study of cases reveals the fact that only a few are adequately drained in the first place or permitted to continue drainage after the primary operation.

The usual teaching and practice of recent years has

been to provide drainage for acute osteomyelitis only down through the periosteum. It has been assumed that any more extensive operating than this in the acute attack may lead to the infection of other portions of the bone and to the opening up of blood and lymphatic vessels through which infection may be carried to other portions

Fig. 8. A well fitting double leg cast or double spica is the desirable method of fixation for lower extremity compound fracture or osteomyelitis. Skeletal pins for fixation of fragments or for traction or ice tongs should be inserted and included in the cast for additional security whenever necessary.

of the body. This teaching seems to have led many operators to provide less than the amount of drainage necessary in these acute cases. There seems to have been some misunderstanding also as to the pathology of acute osteomyelitis. The primary focus has been thought to be just under the periosteum, whereas, as a rule, there is found to be pus in the medulla at or near the epiphyseal

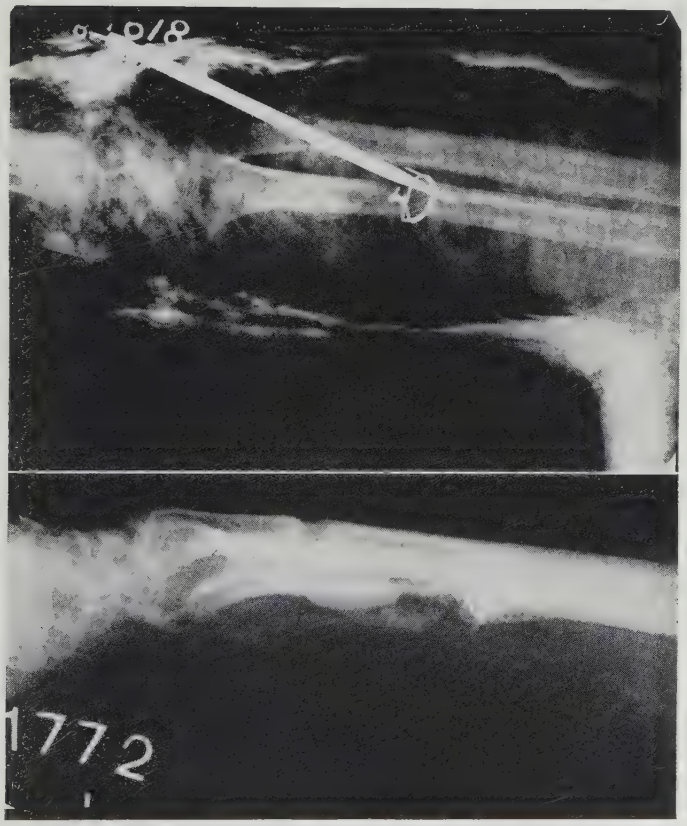

Fig. 9. Showing the use of wire and a pin, the outer end of which is included in the cast, to control fragments in a difficult fracture.

line, that is to say, in the metaphysis, in practically every case.

Adequate drainage into the medulla is therefore the indication and should be done without hesitation or delay in any case where a clear-cut diagnosis of acute osteomyelitis can be made. Wide opening of chronic osteomyelitis cavities is equally important if healing of the entire area following operation is to be hoped for. With our plan of dressing and immobilization, practically all patients obtain immediate relief of all the symptoms, both local and general, and secondary care presents no problems whatever. There is a somewhat different point to be considered in dealing with patients who have chronic osteomyelitis. Dr. Simmons of Boston, who wrote very extensively on the subjects of both acute and chronic osteomyelitis, made the point that the prospect of recovery is much better in patients who have had their infections less than one year, than in others who have had their infections longer. He said that the power of bone regeneration had diminished materially in those who had been carrying infection for a longer time.

Our experience with the Orr method leads us to feel that a distinction between the present and the long standing cases is of less importance than Dr. Simmons suggests. The only really important point is that those patients who can be operated upon before mixed infection has occurred recover much more promptly and with fewer complications than those who must be treated by our method later. If there is mixed infection with severe inflammatory and septicemic symptoms, the patient's outlook is certainly not so good as if adequate drainage and immobilization had been provided in the earlier stages. If the patient has survived the first acute stage, however, even if secondary mixed infection has occurred, adequate

drainage, protection of the wound and immobilization of the parts will often lead to very early and very complete success in obtaining healing.

The following report is quite typical of our experience in a considerable number of cases of this sort.

E. D., age 11, came to the hospital in March, 1929. He had a chronic osteomyelitis of the femur which had been opened on the inner side of the thigh four years previously. He had been dressed every day during those four years, sometimes by the doctor, but more often by the parents at home. He had a large draining sinus with a fairly dense scar on the inner side of the thigh and a good sized sequestrum. He was in poor general condition from chronic sepsis. He was operated upon by our method in June, 1929, a large saucer-like opening being made in the outer side of the thigh and the entire abscess area in the lower third of the femur being opened up. He was first placed in a double plaster-of-Paris spica cast. From June until December he had three changes of cast and three dressings. In December the cast was removed and he has been without a cast since that time. He has been soundly healed now for about two months. There was in this case then a total of four dressings. This was an old, badly infected chronic case of the lower end of the femur in an area in which healing is not easy to obtain. After having had more than a thousand dressings in four years he is now soundly healed in less than eight months with a total of four dressings.

Within the past ten days I have received from Dr. Kleinberg of New York a report of twelve cases of osteomyelitis which he has treated recently by my method. Dr. Kleinberg reports these twelve patients healed with a total of forty-two dressings or an average of three and a half each. The average length of time between Dr. Kleinberg's drainage and vaselin pack operation and healing was about five to six months, while some of his patients had been draining and being dressed daily for several years before that time. One of Dr. Kleinberg's patients was an acute hematogenous osteomyelitis of the

radius with open drainage and a reduction of the fracture in the presence of infection. Healing was obtained with one change of cast and only two dressings.

Some years ago when I first began the advocacy of extensive drainage, the wide open pack and no-dressing method for osteomyelitis, I was warned repeatedly that while the method might be suitable in chronic osteomyelitis it must by no means be tried in the acute cases. The statistics presented herewith more than justify our treatment of these acute septic, often fulminating cases by this method. We may now say without qualification that lives have been saved by the treatment of acute osteomyelitis in this manner. There is not the slightest doubt that bone death and sequestrum formation have also been avoided. Septicemia subsides very promptly and metastasis of infection rarely, if ever, occurs. In the few cases in which multiple lesions have developed when we have operated upon patients in acute cases by this method, we have felt quite definitely that secondary foci had already become established before our drainage operation had been done.

From many other surgeons, also, come reports indicating that their most brilliant results are being obtained in the acute cases. It is in the old chronic cases, with multiple lesions and severe mixed infection, that we have our failures. Numerous acute cases have already been reported, but I submit the following as one of the most recent and one of the most striking.

J. B., age 10, came to the hospital October 13, 1929. This boy had had an acute infection in and about the upper end of the right fibula for six weeks when he came to us. At the same time he was really a case of acute osteomyelitis. No drainage incision had been made. He had high temperature, high white cell count, very great swelling about the leg and knee, and was in every respect an acute septic patient. His operation was done

on the day of his arrival; the fibula and the tissues about the upper end of the fibula were packed widely open with vaselin gauze. A considerable quantity of thick yellow pus was evacuated.

Fig. 10. J. B. Case of acute osteomyelitis of the upper end of the fibula. Sound healing obtained in four months. One change of cast and three dressings only following operation. Illustrations show condition at end of third month.

As usual, in our younger patients, he was put into a double plaster-of-Paris spica with a cross bar between the legs and with the cast extending up to the thorax. This kind of immo-

bilization is the only kind that is of real utility in these cases. His temperature, pulse and other symptoms subsided gradually over a period of four or five days until he was nearly normal.

On October 22 (the ninth day) he complained of a severe abdominal pain and there was a rise of temperature. The white cell blood count, which had been going down gradually during all this time, rose suddenly to 26,000. Our first thought was that he must be having a secondary acute focus of infection either in the leg or in some other portion of the body. There were absolutely no signs of trouble in the affected limb. I had him seen at once by a general surgeon, who located his trouble in the abdomen. While we were considering whether or not he should have a laparotomy his symptoms began to subside and by the second or third day he was entirely over this secondary acute attack. There had apparently been a moderate obstruction of the bowel, because after several enemas he expelled a considerable quantity of rather heavy fecal material. From this point the boy convalesced without further difficulty and at the time of his fifth dressing, at intervals of about one month, he was found entirely healed, February 28, 1930.

The double plaster-of-Paris spica was removed before his departure from the hospital at the end of about seven weeks. Since that time he has worn a cast extending from the hip to the toes on the affected side and it has not been changed. Because he lives a hundred miles from the hospital he has been inspected only once a month, but he has had no further complications or difficulty of any kind.

Although this point has already been mentioned several times attention should be directed to the economy in time, hospital care, surgical dressings, and labor in this manner of caring for such a patient. This boy has had a total of five dressings; he has had one change of plaster cast; his first dressing was done in the operating room, and he has been inspected since at the office down town. I ask you to compare this with the ordinary care of an acute osteomyelitis, where there are weeks of dressings once or twice a day, irrigations, packs, changes of splints or cast, and many days and nights of nursing care due to

failure to get prompt subsidence of the acute symptoms or the complications or sequelæ in such a case.

Prompt recovery has been our usual experience in acute osteomyelitis. In the one or two instances in which patients have reacted badly they came to us entirely overwhelmed and died within a few days. In practically all acute septicemic cases such as used always to react badly, we have had prompt subsidence of symptoms and uninterrupted convalescence.

Failure to make an early diagnosis in acute osteomyelitis has undoubtedly been responsible for many tragedies in dealing with this condition. At the same time fairly early recognition of the fact that there is pus in or about the end of a long bone, with simple incision or even drill holes for its relief, has often been only the first step in a long battle with mixed wound infection, septicemia, sequestrum formation, chronic sinus and deformity or even amputation or death.

A few patients will certainly recover promptly with simple drainage alone, but those severe cases with multiple lesions and deformity that come to our hospitals are usually those that have had what may be called only minor drainage in the first place. It is one of my contentions that even this minor drainage will more often contribute to early and complete recovery if adequate immobilization in plaster-of-Paris is provided at the same time. This is a plan of treatment, moreover, which will enable any competent physician or surgeon to inaugurate early drainage with but little fear of the terrible sequelæ which so often follow incision in these cases. The relief to the patient that is afforded by such immobilization and by avoiding the after dressings can scarcely be described; it must be seen to be appreciated.

In order to direct your attention to the rather unusual possibilities of this method in acute osteomyelitis, I shall relate the details of an operation performed under conditions so difficult as to make a severe test of any method.

In October, 1923, I was called by Dr. Pendergast of Steinauer, Nebraska, to see a girl, fourteen years old, sick in a farm house about sixty-five miles from Lincoln and four miles from the nearest town. I found her in the fifth day of her illness with an acutely inflamed and swollen thigh, obviously the seat of an acute osteomyelitis. The house had no running water or electric lights. The distance to the nearest hospital was about fifteen miles. To add to our difficulties darkness was coming on owing to the approach of a storm. The need for surgical drainage was explained to the parents and permission was obtained to perform the operation with the necessary risks at once in the home.

I ran my car up to the kitchen window to supplement with my head lights the oil lamp which gave us our only illumination in the house. Turning the table so as to benefit from the headlights of the car, we made a lateral incision into the thigh while Dr. Pendergast gave the ether. Copious drainage occurred, both from the periosteum and from the medulla, and after iodin and alcohol our usual vaselin pack was put in. The storm broke outdoors and a terrific rain deluged the countryside as we applied the cast. The patient was put to bed in very good condition and allowed to remain just so for seven weeks, at which time the cast was removed and the first dressing done.

There was no pain or acute symptoms after the first week and the wound was found nearly healed. The cast was left off at this time and a caliper splint put on. The patient went on to prompt and complete recovery and has remained well.

In this case there were no X-rays, bacterial cultures, antiseptic dressings, or hospital care. I have recently had a long distance conversation with this patient and have learned that she has remained well and has no disability.

For several years I have been urged to publish statistical results in my cases. I have hesitated to do so because this brings before the profession results that are better

than those I formerly obtained and than are being generally obtained now, but with which I find no data to make formal comparisons. Many acute osteomyelitis patients die and are listed as cases of septicemia, arthritis, cellulitis, and even rheumatism. I have been at the bedside of a dying patient with an entire extremity full of pus who had been treated until his dying hours without any diagnosis. Chronic osteomyelitis patients leave hospitals and leave their doctors with no record behind them whatever. Likewise fracture patients die or depart from hospital with diagnoses other than osteomyelitis even after a surgical procedure for malposition or malunion in a simple fracture has brought on an acute or chronic bone infection of which no complete record is available.

To obtain statistics in the treatment of osteomyelitis, therefore, has been found to present unusual difficulties. It was hoped that a sufficient number of cases treated by the antiseptic method could be tabulated so that a comparison could be made between that method and the method herein advocated. Such data have been impossible to obtain. So many patients with osteomyelitis not only leave the hospital before the conclusion of treatment, but fail to return for observation by their surgeons, that end-results are not known. A few such cases have, of course, been located, but the record of patients of any particular surgeon or any particular hospital cannot be accumulated in sufficient numbers to justify us in drawing conclusions from them. Even in our own cases such material has not been easy to obtain. I may say, however, that as far as possible every case of osteomyelitis in any form treated by my associate, Dr. Thomson, or myself, during the past eight or nine years, has been included in this report. As far as we know, no case has been omitted for any reason. Some of the results re-

quire explaining, but the figures are here for what they are worth.

We have not attempted any elaborate classification of cases because we find that if we have too many divisions it makes conclusions regarding treatment and results all the more difficult. We have distinguished, however, between those treated primarily by us and those that have been operated upon and dressed (usually with mixed

TABLE I

OSTEOMYELITIS—ACUTE AND CHRONIC

Osteomyelitis	Treated by Orr and Thomson primarily	Treated by Orr and Thomson secondarily	Healed	Not healed	Amputation	Died
Acute	48	27	67	4	3	1
Chronic	15	61	62	9	3	2
Total	63	88	129	13	6	3
Grand totals	151		129	22		

The patient listed as an acute case, sick eight days when seen by us, died in twenty-four hours, Two of the amputations were finger cases; one due to gangrene present upon admission.

infection) by others. We direct attention particularly to our results in the acute cases. These patients were, without exception, patients with acute suppurative processes septicemia, and all the possibilities of osteomyelitis in its acute stage. Some of them had already been incised and dressed before they came into our hands. These, as a rule, were even more sick than the others. Of this entire group, however, a total of seventy-five cases, it is interesting to observe that sixty-nine are now healed, only three are not healed, in two amputation was necessary,

and one died. The patient who died was a patient of my own whom I saw on about the eighth day of his illness. He had an entire lower extremity full of pus and was in delirium from sepsis. He died within twenty-four hours in spite of drainage, which was too late to afford relief.

In a total of seventy-six chronic cases it will be observed that practically all these patients had been operated upon and came to us with chronic infections of mixed character, multiple sinuses, sequestra, often contracture deformity and all the complications we see in this class of cases. Of these, sixty-two are now healed, eight are not healed, in three amputation was performed, and two are dead. One of the patients who died was a man with mixed and extensive multiple infections of the right leg. He died of a secondary osteomyelitis of the left hip and pelvis for which we did not even attempt drainage as his condition was so bad that further operation seemed unjustifiable.

In the amputation cases, one boy, who has a mid-thigh amputation, was treated by me primarily but developed hemorrhage as a secondary complication and really lost his limb because of our inability to control the bleeding. In the chronic cases four patients who are now well, all operated upon by me as secondary patients, had had more than four years of daily dressings before the time of my operation. These four patients had two, three, five, and seven dressings respectively following our operation and treatment by the method described. In the years before our treatment these patients had had a total of approximately five thousand dressings—and were all unhealed. With our treatment they had a total of seventeen dressings and they were soundly healed in an average of four months.

These four patients illustrate in a very striking way

Fig. 11. E. H. Upon admission there was general septicemia and involvement of the entire tibiæ, both legs. Drainage operation only, after five months. Double spica and infrequent dressings (four dressings in eight months) were used. The wound is soundly healed without deformity or disability.

Fig. 12. E. H. Same case as Figure 11. The patient entirely recovered after eight months with one operation, three casts and four dressings.

the great difference between the ordinary treatment and the method by immobilization and the no-dressing method. In the acute cases these differences and the difference as to suffering, necrosis, nursing care and death rate, are even more striking.

One of the important points to be observed in connection with our plan of packing these wounds wide open is that in so doing no pockets of infection are covered over either in the bone or in the soft parts. This is a point that should be observed from the time of the first operation until the wound is soundly healed from the bottom. All of the former methods of suturing, whether of muscle, fascia or skin, are to be avoided for this reason. Neither are skin grafts, muscle flaps, fat flaps, fascia flaps, or grafts of any kind to be used.

In our experience it has not been necessary in a single case to employ methods of this sort as all of our patients have healed under the vaselin pack with little difficulty or delay. The avoidance, in the late stages as well as in the early ones, of frequent dressings and mixed infections is, we think, the principal reason for results of this kind.

Two recent articles on osteomyelitis by Krasnobajev and by Doran and Brown, contain reports of about five hundred cases. These were treated usually by incision, rubber tube drainage, irrigations, or wet dressings, and show a mortality of from 10 to 22 per cent. These were of the hematogenous variety and involved all portions of the body, including the jaw and spine. Comments on these cases indicate that secondary and late infection must have played a considerable part in the results. There is no indication that splinting or immobilization was a factor of importance in the treatment.

Krasnobajev has what appears to be a high mortality rate. His results, however, are probably not very differ-

ent from results obtained by this method of treatment wherever employed. He advocates primary drainage only through the periosteum with counter openings and additional drainage when necessary.

The abstract quotes him as advising against tamponades—I suppose this means packing of the wound in any way. His treatment appears to be inadequate as to drainage. In the abstract of his article nothing is said about splinting or the avoidance of irritative motion as a part of the after-care.

TABLE II

OSTEOMYELITIS

	Acute	Chronic	Healed	Not healed	Amputation	Died
Krasnobajev	428					96
Doran & Brown	42	29	48	13	3	9
Hughes	40					4
Simmons	24	56	51	No record 11-12	0	2
Gaenslen (Orr method)	26	15	35	5	0	1
Orr & Thomson	75	76	129	13	6	3

Doran and Brown depended upon Dakinization as the principal factor in their treatment of both the acute and chronic cases. Their mortality in the acute cases was eight, or 19 per cent. Here again I think we have a fair index of the results obtained by methods in ordinary use.

In making a comparison of their results with ours it will be observed that our death rate was larger in the

chronic cases. This was true for the reason that so many of our patients with chronic conditions came to us with numerous sinuses, sequestra, long standing septicemia, and in generally poor condition.

E. Hedlund reported a series of twenty-one cases and stated that he was having better results with the Carrel-Dakin treatment. Of his twenty-one cases, however, two patients died and four did not heal.

Jopson, in a recent article (1925) on the treatment of

Fig. 13. Condition upon admission of patient to hospital, with history of osteomyelitis of femur for five months; two previous operations; plaster-of-Paris immobilization and infrequent dressings attempted but not fully efficient. We completed the drainage operation down to the epiphysis, packed with vaselin gauze, put on double spica cast and sent the patient home (500 miles) on the fifth day, with instructions to return in four to eight weeks.

chronic osteomyelitis, advised a postoperative pack with Dakinized gauze which was to be left for two or three days; at that time the packing was to be removed and further Dakinization begun. This is contrary to our ideas regarding this kind of treatment. The Dakin pack becomes nothing except a mechanical irritant after the first hour following the operation and causes disturbance both by being permitted to remain and upon removal.

Dr. Gaenslen calls attention to the fact that two patients of his chronic unhealed cases had early and extensive involvement of the ilium. These undoubtedly present great difficulty in treatment, but so far in our own pelvic cases, now five in number, the wounds have all healed. We keep the patients in double spica plaster casts until healed. Dr. Gaenslen's single death was due to septicemia in a child of fifteen.

TABLE III

COMPOUND (INFECTED) FRACTURES
DRS. ORR AND THOMSON. 1921-1929

Cond.	Primary	Secondary	Healed	Not healed	Amputation	Died
Upper extremity	18	10	22		3	3
Thigh	6	10	16		0	0
Leg	20	18	36	1	2	0
Total	44	38	74	1	5	3

2 amputations for gangrene present at time of admission.
1 death within 24 hours of injury.
1 death from cerebral embolism following fracture and extensive burns.
1 death caused by gas gangrene present at time of admission.

The statistics in our second group are of compound fractures which came to us as original injuries with soiled wounds, or with open fractures actively septic after previous treatment elsewhere. Some of these had been simple fractures originally but at the time of coming to us had acute or chronic infections following operation elsewhere and usually deformity, often very severe.

In presenting our figures for patients with compound fractures individual attention should be given to a few special cases. The very good results obtained have led

to the suggestion that perhaps these cases were simpler and easier to take care of than those we get, for example, under war conditions. I may say that two of our patients had compound fractures of both lower extremities of a type as severe as any I have ever seen. One man approaching sixty years of age was caught under a heavy tractor and sustained so much damage to both lower extremities below the knee that amputation seemed inevitable. Because he did have circulation, however, although not very much else, the attempt was made to save both limbs; and the attempt was entirely successful. This man was unable to walk for more than a year, but for two years past now, his injury having been five years ago, he has operated a shop and is on his feet practically all day every day, without any pain or disability whatever.

The other patient, a young woman, was thrown into a stream over a high culvert in an automobile collision and sustained compound comminuted fractures of both femurs. I was summoned to her care at midnight to amputate both legs. The injuries to the bones and the soft parts were very severe and the wounds contained an enormous amount of dirt and debris. She was placed in a double plaster-of-Paris spica with almost no attempt at debridement; we simply used iodin and vaselin packs. Her injury was six years ago and for three years past she has walked to school every day with no pain and with only moderate disability and deformity.

One of the difficulties about arriving at better treatment for compound fractures is that when these patients die, as they often do, we fail to ascribe the cause of death correctly to poor treatment. Death following compound fracture is exceedingly common so that as a rule these patients who die attract less than their share of at-

tention. On the other hand the patients who survive are usually sufficiently grateful to have escaped alive and we are quite likely to confirm them in that feeling, consoling ourselves in the same manner for any disability or deformity that may follow the care of such a patient.

We shall have to recognize the value of the demonstration that we had in the case of compound fractures of the femur during the war, namely, that the difference in death rate alone may amount to 40 or 50 per cent according to the character of the primary and secondary treatment.

A recent operator of extensive experience in the employment of bone graft for fractures reported 158 cases of autogenous bone graft with postoperative infection in twenty-two cases, atrophy and non-union in fifteen cases, and subsequent re-fracture in thirteen cases. This is a total of poor results in about 30 per cent of all operations done. A reading of the article gives one the impression that more efficient postoperative immobilization as well as conservative wound treatment along the lines suggested here would have improved the results of this series.

As has already been pointed out, postoperative infection and failure to obtain results after operation for fracture, as well as the so-called "lighting up" of old infections, all depend to a very large extent upon adequate immobilization in correct position and a let-alone policy with regard to the wound, even including those cases in which active infection appears as a postoperative complication. This is one phase of the operative fracture treatment which it is particularly desired to emphasize in connection with the author's method.

As progressive a surgeon as Dr. Clarence L. Starr of Toronto, who did much constructive work in the treatment of acute osteomyelitis, was still committed in 1924

to the policy of frequent dressings in compound fractures. In his article in the *Illinois Medical Journal* at that time he said that splinting had for its principal object the proper alignment of the limb, the recovery of original length, immobilization of joints above and below the fracture, and, finally, easy access to the wound. The

TABLE IV

Compound Fractures

		Primary	Secondary	Secondary Infection	Non-Union	Healed	Amputation	Died
	Kirk		158	22	28		0	0
	Dennis	61					12	3
	Gaenslen	4	10			11	1	0
Infected	Thomson	22	5		0	19	4	3
	Orr	22	33		0	55	1	0
Non-Infected	Thomson	24	32		0	56	0	0
	Orr	38	65		0	103	0	0
	Total Orr & Thomson 1921-1929	106	135		0	233	5	3

2 amputations for gangrene present at time of admission.
1 death within 24 hours of injury.
1 death from cerebral embolism following fracture and extensive burns.
1 death caused by gas gangrene present at time of admission.

impossibility of reconciling these different features of treatment has already been pointed out.

Dr. Gaenslen calls attention to two interesting points in connection with his compound fracture cases. In a man with a compound fracture of the radius and ulna there was osteomyelitis and non-union. A radical oper-

ation was done, the wound packed with vaselin, a cast put on, and the man was told that a second operation to obtain union would be necessary. Upon removal of the cast it was found that the wound had healed and union had occurred.

The amputation reported was done for a man with an extensive osteomyelitis of the tibia which had healed following the operation and vaselin pack, but which had a defect of about one inch in the shaft of the bone. He was not willing to wait for regeneration of the bone and insisted upon amputation and an artificial limb so that he could get back to work.

One phase of the care of these patients that is of great interest is that which has to do with the late care of patients who have chronic sinuses with fracture deformities, non-union or contractures. In general our teachings in the past have been that these patients may be neither manipulated nor operated upon until sound healing has occurred. In fact, many operators insist that such parts should have been healed for some time before operative procedures of any kind may be undertaken without having the old infection "light up" again.

This attitude is well expressed in the following quotation,[205] a sentiment that I heard expressed many times in 1917-1918:

"Nearly all the surgeons realize that it is dangerous to reoperate in compound fractures until long after the wound is closed. Many surgeons, however, fail to realize that it is almost equally dangerous actively to manipulate the fragments of a compound fracture a few days or a few weeks after the accident. We have many times seen compound fractures progress without active infection for about ten days, when, with the wound practically healed and no evidence of active infection, the surgeon has felt called on to improve the position of the fragments, with the immediate result of developing an active infection."

Our experience led us a long time ago to the conclusion that the dangers in these cases are two only—first, the danger of new infection at the time of operation or at the time of doing dressings; and, second, the failure to employ efficient immobilization following either open or manipulative procedures in such cases. For some years we have been able to perform any such operations and to do manipulative corrections in patients of the kind that we had previously been afraid to undertake. The "lighting up" of old areas of infection has been almost entirely avoided by the plan of performing our manipulations or our operations with as little damage to the parts as possible and by the immobilization and no-dressing method.

This is a point of considerable importance as it enables us to correct deformities which might otherwise be allowed to remain for a long time or even to become progressively worse. As a result of our experience we feel that we can recommend the adjustment of any fracture no matter how much deformity there is or how much infection may be present, if the points above referred to are carefully observed.

Sir Robert Jones and others have repeatedly warned us against the danger of pump-handle methods of manipulation. In such cases it is our custom to place these patients upon a fracture table and to immobilize all the parts before beginning any operation. By gradual traction and forcible correction the fracture deformity may then be adjusted to any desired position with the smallest possible number of movements. Then if additional drainage is necessary, the drainage operation can be performed without any movement whatever, the vaselin pack can be put in and the cast applied in such a manner as to give complete immobilization from the beginning

of the procedure until the patient is back in bed for his convalescence.

As has already been mentioned, the factors of greatest importance in the prevention of deformity and disability in compound fractures are drainage, the placement of injured parts in correct position, and maintenance of that position during the entire period of healing. Other factors are frequently alluded to as having contributed to success or failure in the treatment of these conditions. A restless patient or an unruly one is often blamed for loss of position or for inability of the surgeon to control the fragments in the fracture area. Concurrent sickness or complications are often used as an excuse for removing a splint, changing dressings, or otherwise interfering with the progress of the fracture towards healing. No such conditions should be permitted to interfere except under the most extraordinary circumstances. The attending surgeon should be held responsible for the conduct of the patient at all times and under all circumstances. It has often been observed that the patient who is unruly and difficult to manage is one who has not been relieved of muscle spasm, whose fracture has not been reduced, or whose immobilizing apparatus is deficient. The observance of the fundamental principles in the treatment of fractures is up to the surgeon and he must be held accountable in every case.

In all our dealings with patients who have chronic osteomyelitis I think we shall do well to bear in mind that the organisms to which the patient has become accustomed are not likely to do him very much harm, nor are they likely to become very virulent. This is particularly true if drainage is provided, if the wound surfaces are protected, and if the parts involved are carefully immobilized. Any departure from these methods of treatment.

however, is likely to be followed by new mixed infection, greater virulence, extensive inflammation, secondary abscess and other complications.

By this same plan of treatment we have been able to leave in position bone grafts that had become infected, steel pins and even plates, until union of fractures has occurred. We have found that certain forms of direct fixation of fragments are entirely possible even in infected compound fractures, if the no-dressing method is followed strictly.

Even if there were no advantage to the patient in the matter of wound healing, decrease in suffering or in the avoidance of septic complications, the point of deformity prevention is one to command attention to the immobilization treatment. The maintenance of inflamed extremities in the most advantageous position for subsequent function is a point in surgical treatment generally that has had too little consideration. Every so often some one like Championierre or Willems recommends movement as a therapeutic method for something or for everything with the result that the advocates of rest have to start their campaign all over again, even for rest in the treatment of tuberculous joints and fractures. A difficulty arises in the fact that many inflammatory and destructive bone and joint diseases lead to stiffness and ankylosis. When these occur in patients who have worn splints or casts the immobilizing apparatus is almost invariably held responsible, but it should be remembered that efficient immobilization in all these conditions leads always to the control of inflammation, the minimization of joint damage and the preservation of both form and function.

One may say, I think, that expert methods succeed in the hands of experts to an extent that is almost sufficient in these cases. In other words our results in frac-

tures—in compound fractures—when these patients are under the care of recognized experts and when they have the best treatment, are almost good enough. What is greatly needed at the present time, however, is a standardization of the best technical methods which can be shown to give a high percentage of good results. The insistence upon the adoption of these methods by general surgeons will lead to their adoption by general practition-

TABLE V

FRACTURES—COMPOUNDED BY OPERATION

DRS. ORR AND THOMSON

Cond.	Total	Primary	Secondary	Osteotomy for correction of other deformity	Healed	Amputation	Died
Fracture upper extremity	63	24	35	4	63	0	0
Thigh	29	4	24	1	29	0	0
Fracture leg	67	35	23	9	67	0	0
Total	159	63	82	14	159	0	0

ers to whom the first care of these cases naturally falls.

While it is true that the more highly technical methods and the experts are called upon sometimes only after irreparable damage has been done to the patient, still it must be recognized that better primary methods generally adopted will lead in more cases also to calls for consultation and assistance when they may be required.

In our third group we have placed all of those patients that came to us with deformity and disability (usually both); those for whom at the time of operation, having no acute infection, we have had to do osteotomy, removal

of plates, screws, wire, etc., plastic bone or ligament operations, and finally those of our own cases of simple fracture who have been treated by open method either primarily or secondarily.

In compiling the data by means of which a comparison is made between the ordinary treatment of osteomyelitis and the methods we now advocate, I have included a considerable number of patients whom I treated just following the war. During 1919 to 1921 I was still doing daily dressings, but even during those two years I had already begun to pack wounds open with vaselin gauze and to put on plaster-of-Paris casts in practically all cases. Even the patients who were being dressed daily at that time were being treated in plaster-of-Paris. My method in the beginning consisted of the elimination of irrigations, wet dressings, drainage tubes, sutures and that sort of thing. It was not until two or three years later that I began to extend the time of dressing from a few days up to several weeks.

This appears not only from my notes with regard to cases, but from my correspondence with home doctors who were looking after these patients in the intervals between their visits to the hospital. In order to confirm this point I am taking the liberty of including my correspondence with such a physician during the year 1921. The suggestion contained in that letter has been gradually worked out into the method that for some years now has been employed in all of our cases.

November 3, 1921

Dr. H. Winnett Orr,
Lincoln, Nebraska.
Dear Doctor:

Mr. Arthur Swanson was in to see me about his daughter, Elizabeth Swanson, who was under treatment by you for some time. He wants me to look after her.

Will you kindly give me (1) diagnosis, (2) prognosis and (3) treatment and after-care required in dressings, etc., etc.

Yours truly,
E. S. Case, M.D.
Curtis, Nebraska.

Dr. E. S. Case,
Curtis, Nebraska.
My dear Doctor Case:

Please accept my thanks for your letter of November 3. I regret that through some oversight no letter was sent you at the time this little girl was returned for your care.

She had a chronic osteomyelitis with a small sequestrum in the medulla of the tibia. This was all cleaned out by operation according to the Carrel technic. Our idea is to have the entire wound cavity, including the bone, granulate from the bottom. She has made excellent progress and I think there will be a complete healing unless there happens to be a small splinter of bone that may delay things for a short time. There is no evidence of infection to the bone higher up, and we do not expect that any further surgical treatment will be necessary.

With regard to dressings, it is my policy in these cases to dress only once or twice a week. At that time we do some mechanical cleansing and use the milder dressings such as Balsam of Peru. In the more active suppurating stages of these conditions I sometimes use Dakin's solution but I do not think this is necessary at the present time.

If there is a persistent sinus, exploration or probing where a small splinter of bone is the cause, may be justifiable. I think it is better for her not to use the leg to walk upon until the wound is soundly healed.

Very truly yours,
H. Winnett Orr.

In the children's ward one may see some of the most striking effects of the no-dressing method. Whereas for-

merly the daily rounds of the dressing cart brought on scenes of wild disorder, there are now only rows of quiet beds with osteomyelitis, compound fractures, mixed infections, tuberculous hip, spine, and other such patients requiring no dressings. These patients are all adequately immobilized in closed casts with no worse disturbances to fear than the washing of ears or taking of codliver oil. Once in a month or two they go to the operating room for a change of dressing or cast, which, if necessary, is done under general anesthetic.

Results obtained by the plan of wide open drainage, immobilization in correct position, and infrequent dressings are scarcely susceptible of scientific proof in the ordinary sense. These results can be appreciated only by a clinical experience. I am often asked whether or not I have conducted formal control experiments in animals so that the daily antiseptic method and the no-dressing method can be compared. But such experiments, even if they might be interesting, are unnecessary. I have stood by the bedside of some thousands of patients being treated for gunshot fractures and joint injuries by every kind of splint and antiseptic method. Now, for nearly ten years I have watched these patients in casts and without dressing changes and I have still been able to compare them with unsplinted, movable and fomented patients being cared for by others in beds near by. I can say that in the general welfare of the patient, the avoidance of septic complications, both local and general, the prevention of deformity and disability and the length of time necessary to secure repair of fractures and the healing of wounds, there can be no comparison whatever between the frequent dressing antiseptic method of any type whatever, and the "let-alone" plan.

From many letters and other unofficial communications

in regard to this method of treatment, moreover, I am led to feel that the underlying principles of orthopedic surgery, namely the prevention and control of deformity, reduction in the amount and time of disability, and the modification of deformity producing diseases by rest in correct position, have all been fostered and to an extent already popularized among physicians and surgeons generally. It is earnestly to be hoped that further experience with this immobilization and no-dressing method will contribute to the more general use of adequate splinting and protective methods among the profession at large —a change that has been needed for a long time.

In my own cases I have been persuaded at times, for one reason or another, to modify different features of the plan of treatment as they have been described. It is rather difficult to determine which variations do the most harm. In old and extensive chronic cases I have occasionally yielded to the temptation of too little drainage, especially in the epiphyseal area of long bones; delayed healing and occasional sinuses have been the result. In adult patients there is insistence at times that casts be left off and muscle spasm, pain, profuse discharge and delayed healing are almost invariable in such circumstances. Then there are the old cases with mixed infection and old sinuses when they come in who develop objectionable odors in their dressings and demand early or frequent changes on that account. These patients also have more drainage and aggravation of infection without exception.

The program of treatment as described is not difficult to carry out with children as a rule. Even the children themselves seem to realize their good fortune in escaping dressings. In children, therefore, we generally have our best results. The well-behaved adult patient proves,

however, that exactly similar results may be obtained for him if he will comply with the rules.

We may sum up, then, by saying that the day of active antisepsis in the treatment of osteomyelitis, compound fractures, and other infected wounds is over if only we will have it so. Lister, Thomas, Sir Robert Jones, Morison, Beck, and many others have pointed out the way; we shall be content if we can only help in clearing the path of certain obstacles that seem still to make the traveling a bit difficult.

Finally, I want to say quite frankly that I am not satisfied either with the method I have worked out in the present stage of its development, or with its results so far. I do feel that we have demonstrated that there is a combination of technical methods which gives us better results in infected wounds than the antiseptic method as employed since Lister's time, and that we shall do better to adhere strictly to the surgical principles of adequate drainage, rest in correct position, protection of wound surfaces and the exclusion of infection from open wounds. If we may add to that the rational employment either of chemicals or of biological agents that will combat infection without harming the tissues, we shall be able to make still further progress in the treatment of osteomyelitis and other similar infections.

I believe that we have demonstrated that the correct treatment of the infected wound is, at the present time, far the most important factor in the prevention and cure of septicemia. This is a point which certainly has been overlooked. Lives and limbs can be saved by less meddlesome surgery in the local area and by more careful protection of the patient and the injured and inflamed parts by adherence to these principles.

One must say that a final, conclusive and generally con-

vincing demonstration of the value of the method I advocate can only be carried out in a large compound fracture or osteomyelitis service where methods and results may be contrasted with the others that are now being commonly employed. It is my hope that the work we have done so far will justify one of the larger hospitals or clinics in putting on such a demonstration. As far as I am concerned I should welcome such an opportunity, for the work has progressed far enough for me to feel perfectly convinced of the claims which I have set up and to which you have given such generous and such very cordial attention.

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(Pack cavity with Dakinized gauze; after 2 to 3 days remove packing and begin further Dakinization.)

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(The author emphasizes the important part played by the Thomas splint in war fractures of the femur which were the most difficult of all fractures to handle. This splint reduced the mortality from 80 per cent to 20 per cent, allowed ease and comfort during transportation, and permitted free access to the wound at all times. Abst. by L. D. Prince.)

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